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THE RIGGING OF AMERICAN SAILING VESSELS.

BY FRED M. COOK.

The subject of spars, sails, and rigging, in the days when wind alone was used for the propelling power of vessels, was considered one of the most important factors in the design of ships; while in these times of steam and electricity this subject, as one of importance, has often been neglected, resulting in vessels, which otherwise would be good-looking to the eye of the sailor, being made hideous by masts and rigging so located and proportioned as to completely spoil the symmetry of appearance that pleases the nautical eye. This is particularly noticeable in a great many steam yachts—a class of vessels where appearance is considered of prime importance.

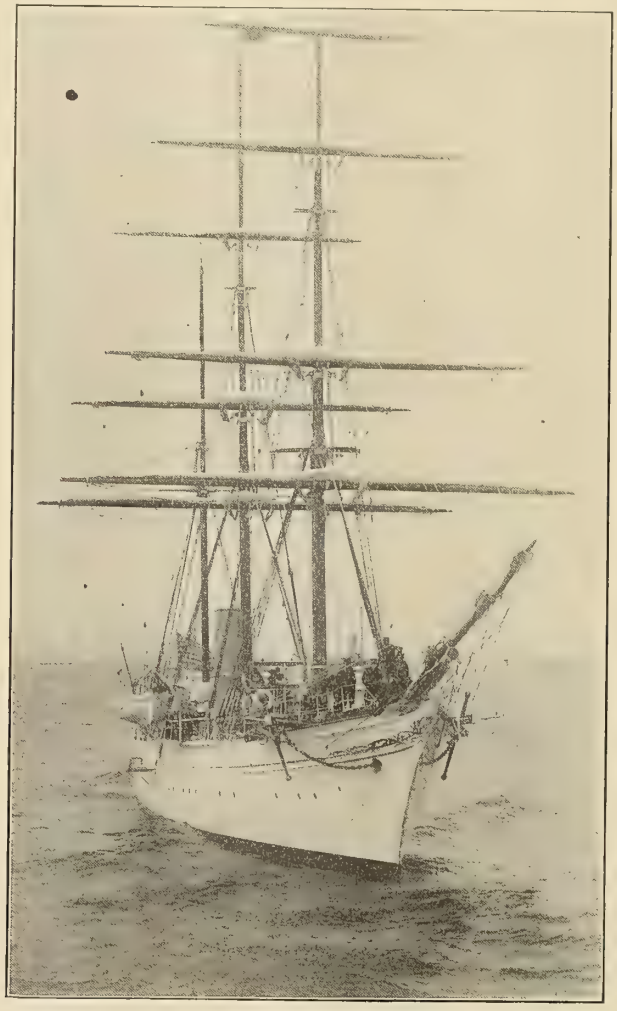
Of the various rigs used for sailing vessels, the four-masted ship, or, correctly speaking, the shipentine, is the grandest vessel that ever sailed the seas. These vessels are at present used mostly in the trade between San Francisco and European ports, returning by way of New York or Baltimore, or in carrying case oil to Asiatic ports from the oil centers of the United States. The grand fleet of three-masted ships and barks are fast disappearing from the seas or being converted into

MODERN FOUR-MASTED SHIPENTINE ASTRAL.

(Copyright, 1903, by Marine Engineering, Inc., New York.)

barges, as, in the competition with the tramp steamer, only the ship of very large cargo capacity can be run profitably, and then only on long trips. The American schooner will, in all probability, for a great many years to come hold its prestige for the coastwise bulk cargo trade of the Atlantic coast, and a few of these vessels are at present engaging in the offshore trade. This class of vessel has proven very profitable in most cases, and some equal in size the largest square-riggers afloat.

There are numerous other rigs used for various trades, such as the barkentine, the topsail schooner, the sloop, the yawl, etc.



AUXILIARY STEAM YACHT WHITE HEATHER; BARK RIG.

[Photograph by E. Muller.]

The modern steamer for merchant service carries very few sails, and those only for steadying purposes in a seaway. A great many of the latest steamers only carry masts for derrick uses in handling their cargoes.

The masts of this class of vessel being mostly of steel construction, the rigging connections are usually formed by forged bands with eyes and fitted to set down on a butt lap of plating, or by heavy pad eyes riveted to mast, into which the shrouds and stays are shackled; the stays, being single, are spliced over thimble in shackle, while the shrouds are worked in pairs, the shackle being in the bight with heavy wire seizing to prevent the bight slipping. Wire rope is used entirely for all standing rigging, and is usually served, though in some cases this is omitted. Where hemp ratlines are used it is desirable to have serving to prevent them from slipping down. Sometimes the shrouds are served, and not the stays, except over the splicing at the ends. The lower ends of the shrouds are spliced over cast hearts with two holes, the upper to take the sheer pole and the lower one to take the turnbuckle. The turnbuckles are fitted with jaws in both ends, and a lock nut to prevent the buckle from loosening up when the ship is thrashing in a seaway. The backstays are usually set up in the same way as the shrouds, with the omission of the sheer pole. On the headstays the turnbuckles are omitted and the stay is set up on end, which is, that the end is rove around a thimble in a shackle, turned up and lashed, the end of the rope being covered with a brass cap to prevent unlaying.

Where wood topmasts are used the rigging can best be connected by an eye splice around same, supported by a funnel or bolster to prevent working down.

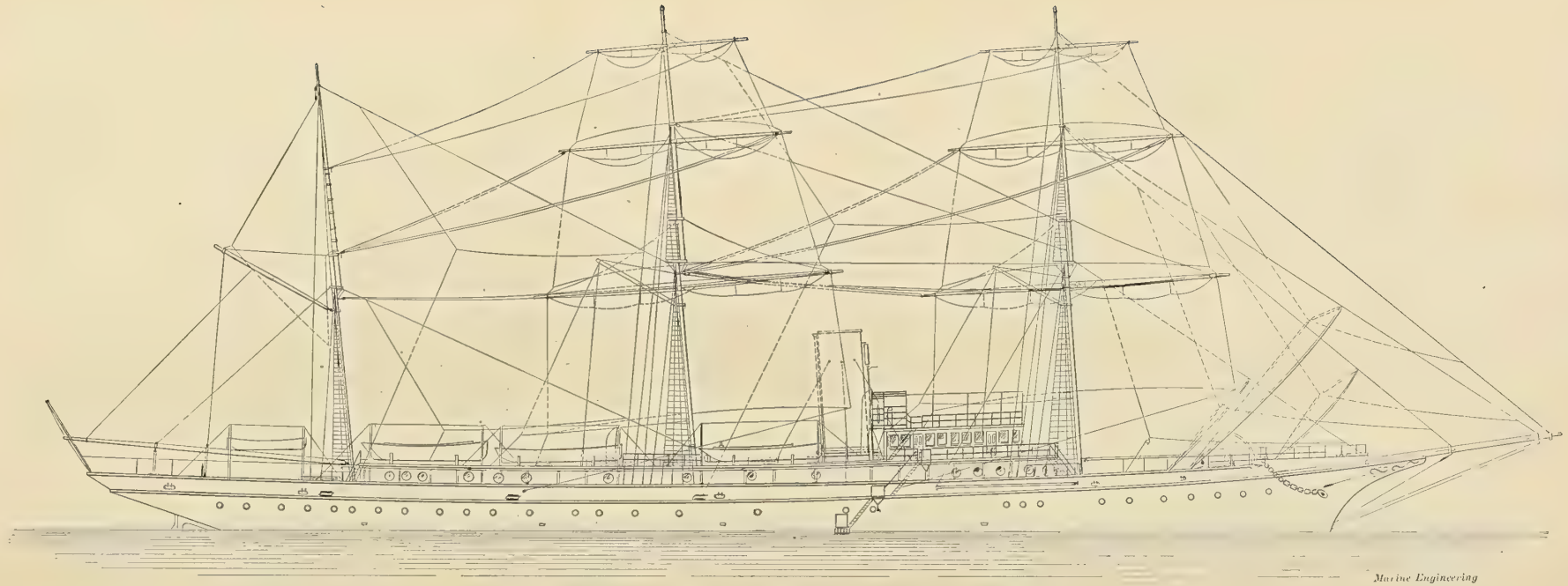
The sparring and rigging of the steam yacht are

important features in her make-up and should receive careful consideration by the designer. It is impossible to go by any strict rule for locating and giving length for the spars of this class of vessel, as there is such a variety of styles and make-up of hulls and also the different requirements and fancies of the prospective owners.

One of the handsomest specimens of this class of rigged steam yachts is the *Aphrodite,* built and designed by the Bath Iron Works, of Bath, Me., a description of which may be of interest. This yacht is 302 feet long and is rigged as what is called amongst sailors the "jack-ass bark" rig; that is, bark rig with the fore and main masts the same length instead of the main being longer,

A RELIC OF THE OLD DAYS, THE NAUTICAL TRAINING SHIP ST. MARY.

[Photograph by E. Muller.]



RIGGING PLAN OF THE STEAM YACHT APHRODITE; BARK RIG.

as is usual in the bark rig. She is fitted with courses, single topsails, and topgallant sails on the fore and main, with a fore-and-aft spanker and working gaff topsail on the mizzen; main and mizzen and mizzen-topmast staysails and three jibs. The following is a list of the sizes of wire rigging used on this vessel:

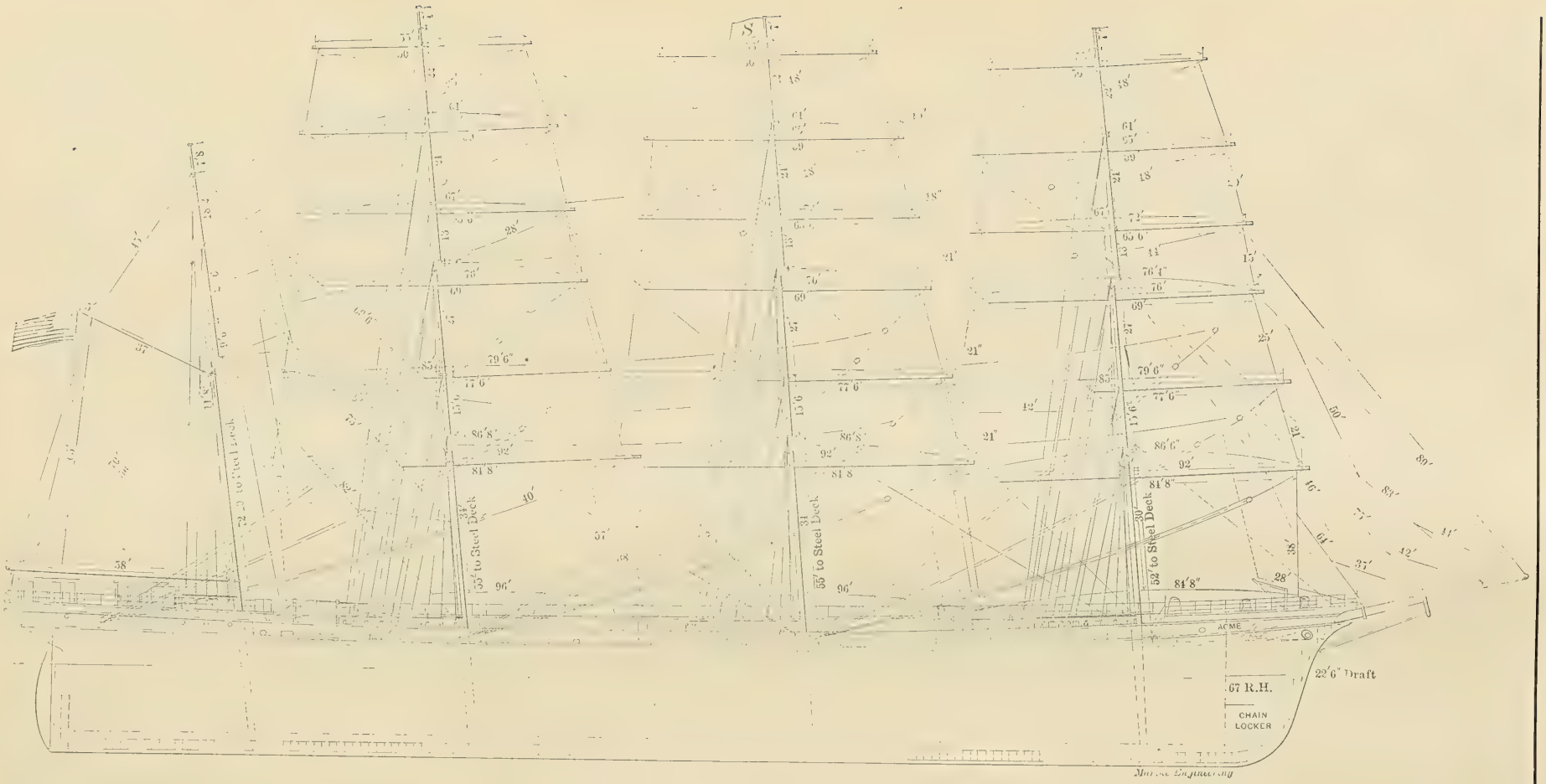
	Inches circumference.
Fore and main shrouds	3¼
" " " backstays	3
" " " topgallant backstays	2¾
Mizzen shrouds	3
" topmast backstays	2½
Fore topgallant stay	2½
Flying jibstay	3
Jibstay (double)	3
Forestay	3¾
Main topgallant stay	2¾
" topmast stay	2¾
Spring stay	2¾
Mizzen topmast stay	2¾
Mizzen stay	3¾
Peak lifts (standing gaffs)	3
Topmast rigging (all masts)	2
Topgallant lifts	2
Topsail "	2½
Topgallant foot ropes	2
Topsail " "	2¼
Fore and main foot ropes	2¼
Flemish hawsers	2
Foot-rope stirrups	2
Vangs	2
Inner jibboom guys	3
Outer " "	2¼
Middle " "	2¾
Ridge ropes	1¾
Boat davit guys and spans	1¾
Dinghy davit guys and spans	1½
Stack guys	2¼
Outer bobstay	3
Inner "	1½ inch diameter solid rod

The most interesting class of vessels, as regards spars and rigging, are the sailing vessels of the merchant marine. The leaders of these are the beautiful four-masted square-riggers engaged in the deep-sea trade. Most of these vessels have, as previously mentioned, what is commonly known as the shipentine rig, with square rig on the fore, main, and mizzen masts and fore-and-aft rig on the spanker mast. On the larger vessels of this type it has been found best to fit double topgallant sails as well as double topsails to facilitate handling in heavy weather, though the old way of single topsails and topgallant sails was in all probability the faster rig. On a vessel of this rig the yards of the courses, lower topsails, and the lower topgallant sails are fixed, while the other yards hoist. The masts are usually fitted in three sections, namely, lower mast, top-mast, and with the topgallant and royal in one piece,

though in some of the latest steel ships with steel spars the lower and top masts have been made in one section, making only one doubling for the entire spar. The topgallant and royal masts are usually of wood. Owing to the great saving in weight, as well as increased strength, steel is being used almost entirely for the larger spars on the larger class of square-riggers.

THE PASSING TYPE OF THREE-MASTED WOODEN SHIPS.

On these vessels the fore, main, and mizzen are practically duplicates as regards sails, so that in describing the fittings for one we have them all. The lower yards are secured to the mast by what is called a truss, composed of a pinchband on mast, fitted with double flat links on forward side, between which a heavy forged arm is worked, connected to the links by a through bolt, forming a horizontal joint, allowing the yard to swing sideways for trimming the sails; this arm, about thirty inches long, connects to a yoke on the yard by passing through with a shoulder, forming another joint, allowing the yard to swing vertically, or what is known as "cockbilled." This yoke is connected to the yard by two heavy pinchbands. The weight of the yard is carried by a heavy chain sling leading from an eye under



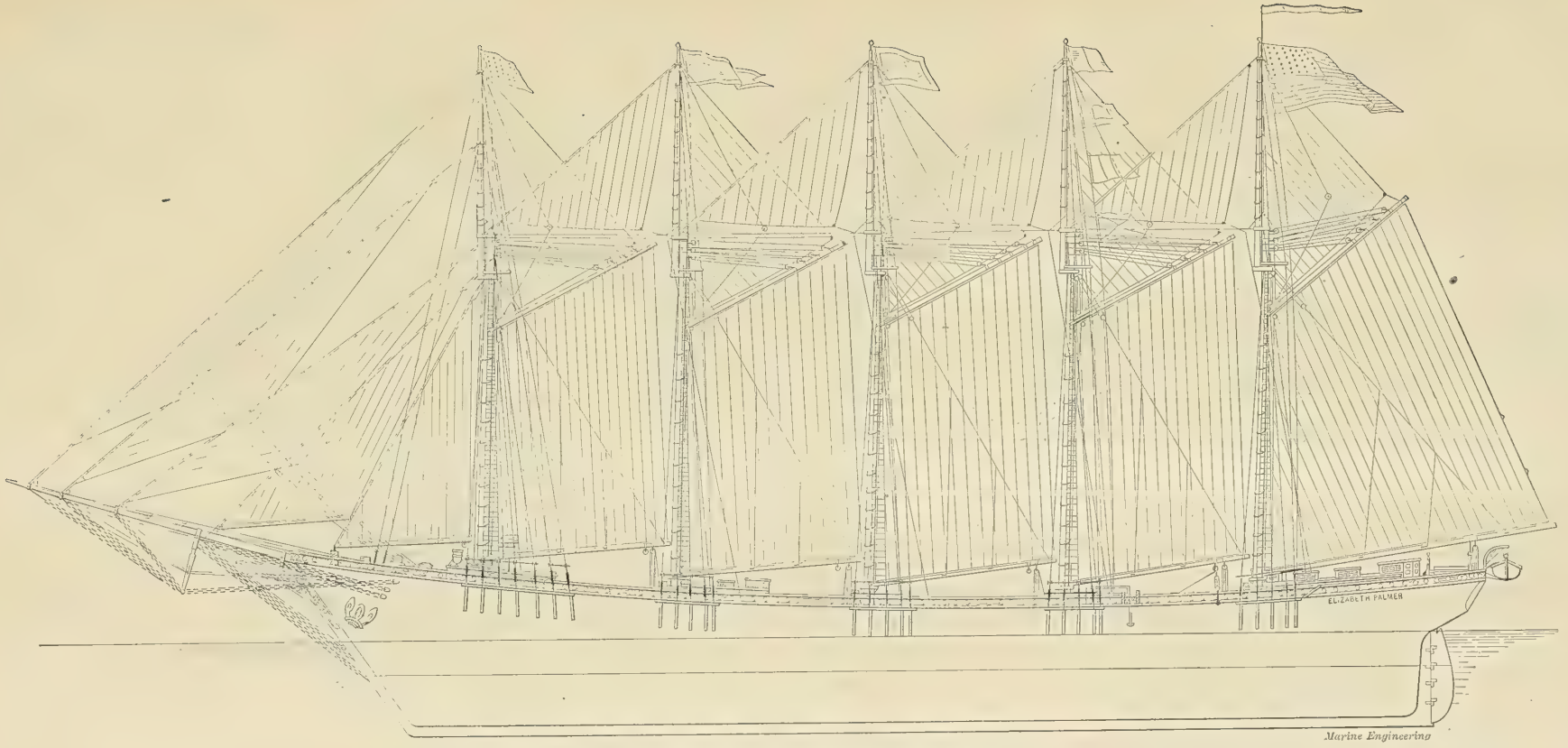
SAIL PLAN OF THE FOUR-MASTED SHIPENTINE ASTRAL.

the top to a band located on the yard at center between the two yoke bands.

The lower topsail yard is usually carried by a truss similarly constructed, but made to span the topmast doublings, and located about one foot below the cap band. The weight of this yard, when double topsails are used, is taken by a forged strut from an eye on the top to a band at center of yard. When single topsails are used the weight is carried by a sling from the topmast head. The arrangement for lower topgallant yard is the same as for lower topsail, except that it is of lighter scantling.

The remainder of the yards are fitted with what are called tubs—that is, with a heavy wood chock fitted to yard and reaching half-way around mast, with a heavy forged bail around the remainder of the mast, and all covered with leather for chafing. This is a loose fit around mast, that it may work easily even if the yard is slightly canted. The ends of the bail are secured to wood chock by a hinge joint, so that by drawing the pin at one end the bail can be swung open, and the yard unshipped.

All yards are fitted with rod jackstays on top side, to which the sails are bent. These rod stays pass



SAIL PLAN OF FIVE-MASTED SCHOONER ELIZABETH PALMER.

through small forged screw eyes on the yard. The yards are also fitted with eyes for foot ropes, foot-rope stirrups, etc., and band at each end with eyes for the lifts, clews, and braces, also bands at ends of arms for reefing.

The after or spanker mast of these vessels is usually fitted similar to a schooner, except that the lower mast is rather short and a topgallant mast is carried. The top and topgallant masts are used more for leading the braces of the mizzen upper yards to, than for supporting sails, though a gaff topsail is usually carried. A top is not fitted to this mast, but in its place is fitted trestletrees similar to the fore, main, and mizzen top, and topgallant doublings with the omission of the spreader.

Some of the latest American vessels of this rig have rather a peculiar arrangement of sails for this mast, the spanker being fitted in two sections, the split being from throat to clew. By this arrangement, when sail is shortened the upper section is taken in, leaving a three-cornered or leg-of-mutton sail, which makes a very convenient sail for heavy weather, especially when it is necessary to lay-to. When rigged this way the gaff is fixed and is fitted with a gooseneck, and is located at the masthead cap instead of only hoisting to about six feet below the hounds, as by the old arrangement of hoisting gaff.

The spanker boom is fitted with a gooseneck at mast, which is usually composed of two pinchbands on mast, about six inches apart, with lugs on after side through which passes a heavy bolt connecting the bands. On this bolt between the bands a forging is fitted which allows the boom to swing. This forging connects to

the pacific iron on the end of the boom by a hinge joint, allowing vertical swing. The pacific iron is a split cap over end of boom, with lug on end for connection to the hinge joint, and is through-riveted to the boom. This boom also has a sheet band and a band at end with eye for hauling out the clew. The sheet band is a two-section pinchband with the bolts in one lugs on bottom and sides for taking the bobstays and bowsprit shrouds. The bobstays are generally of solid rods with shackle connection at stem, and the bowsprit shrouds of wire rope with turnbuckles at the bow quarters.

The matter of hull connection for the standing rigging of a ship of this class is very important. The

TYPE OF MODERN FISHING SCHOONER.

piece, forming a U-shaped bail on the under side for the sheet block to travel on.

These vessels carry what is known as a spike bowsprit—that is, all in one piece and of round section, constructed of steel. The plating is arranged so that the butt laps form shoulders for the bands that take the jib and bobstays. The bands are usually fitted with double lugs on top side, with bolt and thimble between. Over these thimbles the stays pass, setting up on end at the knightheads. These bands also have

combined working strength of the standing rigging of a vessel of this class is about two thousand tons, which gives some idea of the enormous strains on the hull connections. The shrouds and backstays connect to the sheer strake by heavy pad-chain plates located on inside of bulwarks. These shrouds and backstays are fitted with turnbuckles above the sail for setting up. The mast and topmast stays set up on end at heavy pad eyes located on deck at foot of the mast, the forward one being stayed.

The most important class of sailing vessels in the American merchant marine of the present day are fore-and-aft schooners of the coasting fleet. These vessels are very popular on account of their simplicity of rig and economy, being manned by a crew of about half the number required for a square-rigger of the same tonnage. The sails of these vessels, while very large in the case of the larger ones, are very easily handled, as the work can be done almost wholly from the deck, work aloft only being necessary in furling the gaff topsails and topmast staysails, which sails are not usually carried in heavy weather. The advent of the steam hoister has also proven a means of great economy for this class of ships.

The majority of these vessels are of wood construction with wood spars. The lower masts are of Oregon pine; the topmasts, jibboom, booms, and gaffs of spruce or Oregon pine; and the bowsprit of yellow pine. The masts are fitted with wood trestletrees at the hounds for taking heel of topmasts, supported on forward side by heavy oak chocks or supporters for carrying the weight. Wood spreaders are fitted on top of the trestletrees for the topmast backstays. At the masthead a heavy forged cap is fitted and securely fastened by through bolts to the head, and has band on forward side for taking the topmast. At the topmast head a shoulder is worked in the spar, on which a tapered band sets. Over the top of this band sets a round forged

A FULL-SAIL BREEZE.

grommet, and the topmast rigging is fitted with spliced eyes and dropped over head and rests on this grommet, which, being of round section, prevents cutting of same. At the head of the topmast pole a band is fitted with eyes for taking stays and signal halyards. The booms and gaffs are fitted with oak jaws at masts and forged bands for taking sheets and clews.

The bowsprit is of square section and built up of yellow-pine timber, and is fitted between knightheads at bow, and steps in heavy wood bitts under the forecastle deck. At outer end a heavy cap band is fitted to take the jibboom, and has an eye on under side for taking the martingale or dolphin striker, which acts as a spreader for the jibboom bobstays, which are usually of chain. The bowsprit bobstays are of heavy chain, usually two in number, and connecting to stem of vessel by heavy forged straps through-riveted to stem. A turnbuckle is fitted at outer end of each for setting up.

The shrouds are worked in pairs, passing around masthead over bolsters on trestletrees and seized. The chain plates are in the form of heavy straps on the outside of the vessel, securely fastened to the plank and framing. Turnbuckles are fitted above rail, with the sheer pole lashed to upper end, or with rod passing through the hearts in the splices at ends of the wire rope. The backstays are fitted in a similar manner to the shrouds, with the omission of the sheer poles. All the standing rigging is of galvanized wire rope, and, with the exception of stays on which sails slide, is usually served with marline.

The topmast rigging leads to ends of trestletrees and sets up with deadeyes and lanyards, with futtock shrouds of solid bars to a band on mast about six feet below the hounds. The bowsprit and jibboom shrouds or guys set up at the catheads with turnbuckles.

Among the smaller vessels of this rig are found some handsome and seaworthy craft, such as fishermen, pilot boats, and yachts. These are usually two-masted vessels, with the masts set well forward and the foremast somewhat shorter than the mainmast. This arrangement gives a larger mainsail, which helps the sailing qualities, especially in windward work.

Turbine Channel Steamer Brighton.

There was recently placed on the New Haven-Dieppe service across the English channel a new steamer named the *Brighton,* built by William Denny and Brothers, Dumbarton, and fitted with Parsons steam turbines. The hull of the *Brighton* measures 282 feet by 34 feet by 15 feet 2 1-2 inches, and the gross tonnage is 1,130 feet. She is but slightly larger than the *Arundel,* hitherto the finest boat of the fleet, which is 277 feet and of 1,060 gross tons register. The latter boat has accommodations for about 900 passengers, while the *Brighton,* because of her slightly increased size and the smaller space devoted to engines, will carry a hundred more.

There is one high-pressure turbine, set on the center line of ship, designed to run at 700 revolutions per minute, driving a single screw; and two low-pressure wing turbines, each driving a shaft and single screw at about 500 revolutions. Reversing turbines are fitted at the after end of each low-pressure turbine. The arrangement is similar to that of the *Queen,* described in the September, 1903, issue of Marine Engineering. Steam is supplied from four single-end boilers designed for a working pressure of 150 pounds. The entire lubrication is automatic, and it is said that the consumption of oil is practically negligible in comparison to that on the *Arundel.* The engine room is remarkably small for the power of the engines, but, apart from the auxiliaries, there is nothing whatever to be seen in it save the turbine casings, the shaft, and the pipes. Condensers are placed between the low-pressure turbines and the side platings of the vessel, the cooling water being circulated by centrifugals driven by small compound, inverted engines which also drive the air pumps. Though more powerful than the engines fitted in the *Arundel,* the adoption of the turbine has enabled the owners to reduce the engine-room staff by two. The *Brighton* is very handsomely fitted up for day and night service, with large cabins forward for first-class passengers. The after end of the ship is devoted to second-cabin accommodations.

The chairman of the Southeastern Railway Company, owners of the turbine channel steamer *Queen,* has stated that although nine minutes quicker than the *Victoria* and the *Empress,* the two most recent twin-screw reciprocating-engine vessels, the *Queen* only burns the same amount of coal, and has four men fewer in the engine room.

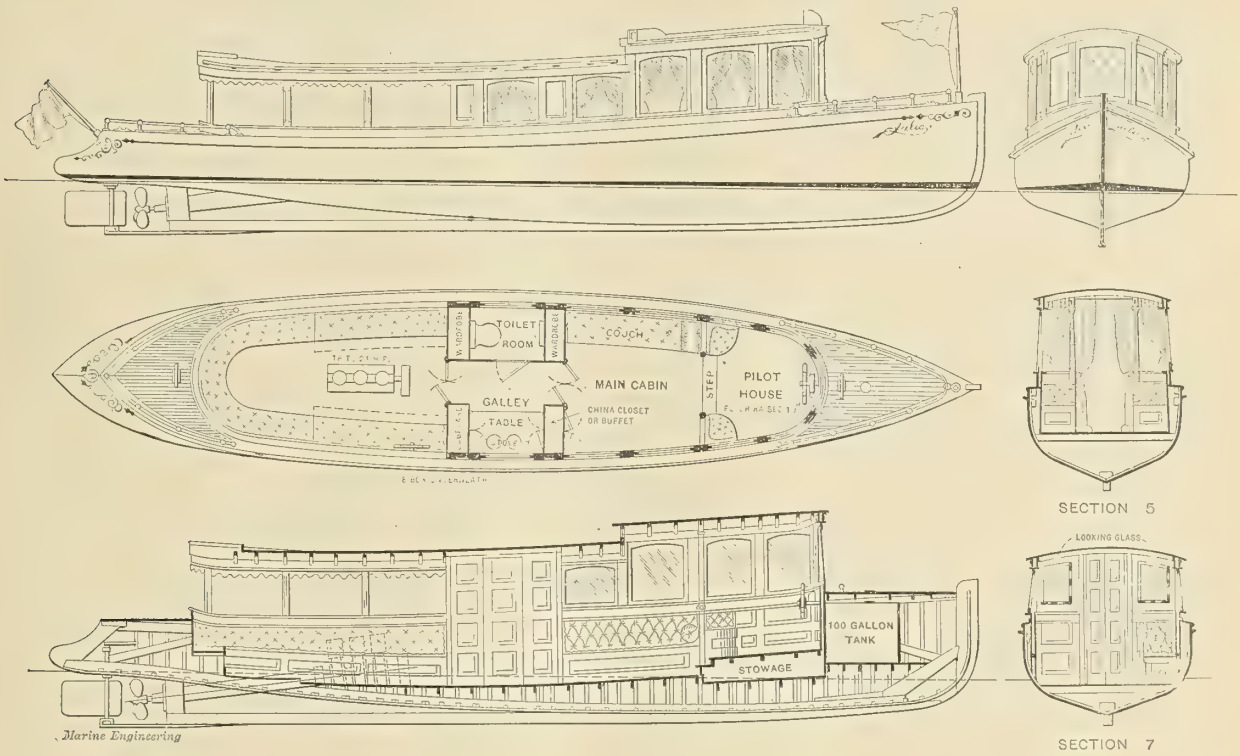
Electric Haulage on Canals.—In a recent issue of the *Revue Technique,* M. Georges Petit gives an interesting discussion of electric haulage on canals. Recognizing that the principal problem was one of traction, it is necessary to consider two methods—one in which the motor travels on an ordinary road, and the other in which it runs on rails. The first system gives a higher tractive effort for a given weight of motor, but it takes more power to move the motor itself, and the efficiency of the system is less than when the motor runs on rails. In studying the problem, the power required to overcome the inertia of the boat is easily computed from its known weight. That, however, required to overcome the friction of water when confined in a canal could only be determined experimentally, and, to do this, boats were brought up to a known speed and were then allowed to drift after the tractive force had been cut off, their rate of retardation being noted. From the retardation curves and the computed inertia, acceleration and power curves were constructed, both for motors traveling on an ordinary roadbed and on rails. The results show that the rail system is superior to the other, and that it will be less expensive to keep up, although the first cost will be greater. It is the author's opinion that mechanical haulage on canals will surely be adopted in the future, and he believes it will be entirely successful. Moreover, the systems will be operated electrically, because this is the most efficient and reliable method of supplying the power.—*Electrical Review.*

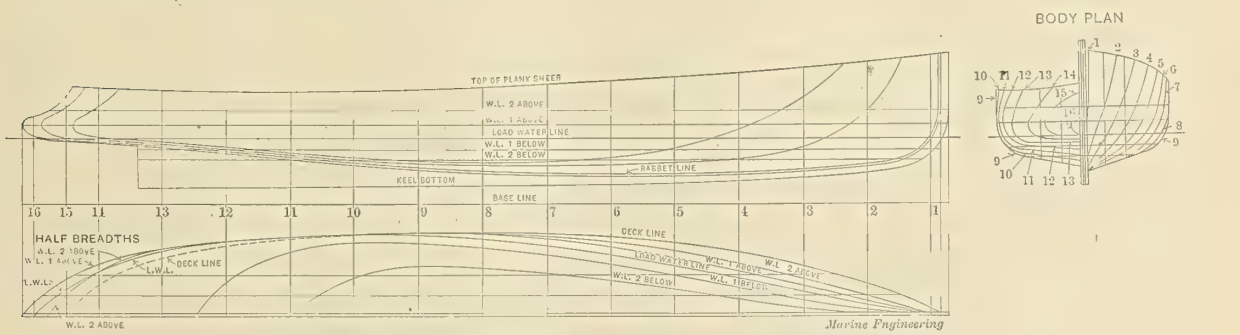
Errata.—In the December, 1903, issue of Marine Engineering, on page 623, column 1, line 11, correct *Celtic* to *Minnesota;* also page 635, column 2, second line above cut, correct 68 to 65.

Half-Cabin Cruising Launch.

The drawings on this page are of a 41-foot half-cabin cruising launch, designed by the Wolverine Motor Works, of Grand Rapids, Mich., for Mr. Morris Shanahan. The purpose of the design was to have made a good, comfortable cruising launch, and, at the same time, to have a large, open cockpit and give the boat a good speed.

intercepts the water line at the stern. As will be seen from the lines, full buttocks are carried well aft and the center of the water planes makes a raking midship section. A heavy deadwood is carried aft to support the propeller and rudder and to give a strong backbone to the boat. Deck floors are worked in forward. The planking is of 1 1-8-inch cypress, and it is evident that the boat is strongly built.





CONSTRUCTION PLANS AND LINES OF A 41-FOOT HALF-CABIN CRUISING LAUNCH.

The general dimensions of the boat are:

Length on deck, 41 feet.

Length on water line, 43 feet.

Beam over all, 7 feet 8 inches.

Maximum draft of hull, 1 foot 10 inches.

Extreme draft, light, 2 feet 5 inches.

The freeboard is 4 feet 3 inches, dropping to 2 feet 4 inches at the stern, while the lowest point of the sheer is but 2 feet 11-2 inches above the water line. The greatest depth of the hull is forward at about the fifth section, rising by an almost flat curve aft till it

A gasoline tank, containing 100 gallons, is stowed forward of the pilot house. The floor of the pilot house is raised; large plate-glass windows are on front and sides. In the cabin a couch is fitted on the port side, all upholstery being of plush, while the curtains and the portieres are of damask. The finish of deck and cabins is in mahogany. Amidships are lockers, toilet room, cupboard, and galley, while in the open cockpit aft is placed a 3-cylinder, 18-horse-power Wolverine motor.

The boat is to be used in Miami, Florida, on the coast and inland bays.

SHIPYARD ECONOMIES.—I.

BY R. S. HUBBARD.

At a time like the present, when the very existence of the American shipbuilding industry is seriously threatened by conditions which are beyond the control of the shipbuilder, there is a natural tendency to abandon the consideration of ways and means of effecting economies in production under the stress of anxiety about the future.

While, however, the prospect is gloomy with respect to construction of vessels for the oversea carrying and passenger trades, owing to the present unfortunate position of shipowners and the comparative dearness of labor and materials in this country, the future of warship building by contract with the government, and that of construction for business and pleasure traffic in home waters, appears to depend largely upon the ability of shipbuilders to carry out their work with efficiency and economy.

While economy is, or ought to be, the lifelong study of those who undertake the responsibilities of organization and supervision, and is as necessary in times of the greatest prosperity as in times of depression, it generally happens that such means of inaugurating economies as changes in organization, alterations to and improvements of plant and reductions of wages, can most conveniently be taken advantage of when, as at present, the personnel is reduced in numbers and output is small.

When it is remembered that during the last few years it has been no uncommon thing to find shipbuilding contracts being entered into, carried forward, and completed simultaneously with the design, construction, and organization of the plants themselves, there can be no very grave reflection cast upon the ability of those entrusted with such exacting labors and responsibilities by suggesting that, in the rush of affairs, economical possibilities may not always have received the thorough attention that they deserve and even require.

The subject of shipyard economy is one which is never likely to be reduced to an exact science, but it is certain that intelligent examination and consideration of the circumstances in which, or in spite of which, economies can be effected, will enable many suggestive inferences to be drawn.

Setting aside the problems connected with design and market prices as being beyond the range of the present discussion, the practicable economies of ship construction can be roughly classified for consideration as follows:

LABOR.

1. Employment of unskilled or cheap labor upon all jobs not necessitating skilled operation.
2. Reduction of the employment of skilled labor to the minimum limit.
3. Prevention of loafing.
4. Reduction of overtime to the minimum limit.
5. Piecework rates and premium systems.
6. Abolition of timework for squaring up piecework.
7. Time rates.
8. Economy in finish.

LABOR CONTROL.

1. Proportioning the numbers and timing the operations of the various gangs so as to prevent delays.
2. Arranging the work so that the progress made by one gang or individual workman can be checked off against that made by others.
3. Under-foremen and leading hands.

ORGANIZATION.

1. Preparation and transmission of plans, lists, and other information to superintendents, foremen, and workmen.
2. Working understanding with owners' local representatives.
3. Systematic preparation and storage of fitting-out details.
4. Scope of operations of various departments.
5. Efficient supervision.
6. Standardization and specialization.

PLANT.

1. Arrangement of building and yard.
2. Use of power-driven portable tools worked by cheap labor.
3. Power station economies.
4. Transportation.
5. Arrangement of power-driven fixed tools.
6. Up-keep and new construction.
7. Shop economies.

MATERIALS.

1. Orders and deliveries.
2. Store department organization.
3. Sawmill and woodyard organization.
4. Steel and iron yard organization.

Let us now consider these items in the order given above.

LABOR.

1. *The employment of unskilled or cheap labor upon all jobs not necessitating skilled operation* is a first principle of economy which, it will be very generally admitted, requires tact and resolution to put into practice, and also keen observation and practical knowledge for the discovery of opportunities. The following are a few illustrations of cases in which this economy has been, or might be, effected, while it is safe to say that each plant has its own peculiar possibilities.

(*a*) All material prepared in the mill or shops may be transported to vessels under construction by unskilled labor, with or without the aid of mechanical transport, and in some cases may be actually put in place for fastening; yet it is no uncommon thing to find skilled workmen leaving their job on board the ship to walk to the shop, store room, or mill, wasting their own and other people's time in order to find some material they require, and finally carrying it piecemeal on their shoulders to the ship.

Under-foremen do not always realize that in such ways as this their men may often be conscientiously attending to their work while they are wasting time and money. While it is easier to arrange means of preventing waste of this sort in large plants than in small ones, it is often found advantageous to provide a "runner" for each large vessel or a convenient number of smaller ones. The "runner" is assisted by a gang of laborers, receives written notes of the material required each day by the foremen in charge on board the ships, notifies the

shop foremen, and sees that the material is brought on board as it is required. He also conveys molds and instructions from the ship to the shop as required.

(*b*) The whole of the structural ironwork of a ship can be first and second coated with paint by unskilled men, and almost 50 per cent. of finishing work done by the same labor, yet in some yards no paint is put on by any one but skilled painters.

(*c*) A great deal of work of such descriptions as laying keel blocks, launching ways, moving shores and ribbands, and even erecting uprights, getting up beams and frames, etc., is frequently done by gangs composed of shipwrights exclusively. In many cases the gangs can be made up of a mixture of skilled and unskilled men in a ratio of about 2 to 5, and will then actually turn out more work per man.

(*d*) In view of the possible combination of the mold and template systems of steel construction, which is at present the subject of a good deal of consideration, it may be remarked that while, generally speaking, those portions of the structure which require furnacing are most satisfactorily carried out by skilled workmen using their own templates, all the straight work is much simpler and could be undertaken by cheap or partially skilled labor working from molds.

2. *The reduction of the employment of skilled labor to the minimum limit* is rather more than a mere complement of the preceding section, because, apart from the fact that a skilled workman is not required to do work which can be accomplished by an unskilled man, the problem is involved of reducing as far as possible the number of operations which can only be carried out by skilled labor.

This problem is a far-reaching one, and is connected with other economical considerations which would not be appropriately discussed under a labor classification.

For example, the modern practice of employing steel and other castings for purposes formerly served by blacksmith and anglesmith work, the whole subject of the employment of power-driven and automatic tools and labor-saving devices, as well as considerations of finish and detail design, have for their object the attainment of economy in this direction, and will be touched upon later on.

3. *Prevention of loafing.* The workman who never wants to loaf may be a *rara avis*, but he is not nearly so rare as is sometimes supposed. Most men can and will work steadily if they thoroughly understand what they are expected to accomplish and if they know that there is another job ready for them as soon as the present one is completed. The "born-tired" man is easily discovered and weeded out if he is looked for. Although in some cases an under-foreman's gang may be so widely scattered that he cannot visit each individual of it more than four or five times a day, it may generally be assumed that an idle man is generally produced by an under-foreman's inefficiency or lack of sufficient instructions.

This aspect of the question, then, leads directly to the subject of *efficient supervision,* but there are several other cases which must be attributed to special causes.

When a man has passed the ticket office and the day's work is before him, it is not in average human nature to be in any particular hurry to commence. A man may wish to finish his smoke or his chat with his mate, he may not have fully digested his last meal, but, in any case, he has no great inducement to show a good example by being the first to pick up his tools. Before stopping time, again he is exposed to a strong temptation to put the tools away, get his overalls off, and be ready to make a bolt for the gate as soon as the whistle sounds.

There is only one effective check on this kind of thing, and it lies in the character and punctuality of the superintending staff. Some firms have employed a system of private policing to overcome the difficulty, but it has resulted in the suppression of appearances rather than in effective prevention. Whatever the means made use of, however, the tendency must be continually kept in check or it grows rapidly.

In very large plants, ticket offices have been erected in convenient places near the building slips, fitting-out basin, and principal shops, each man's ticket or time check being issued to him and collected as nearly as possible to his working location, to the end that the five or seven minutes which he occupies in walking from the gate to his work and vice versa do not form part of his working day. A few years ago it was not a very difficult matter in some plants for an employee to take advantage of some weak point in the time-keeping system or the ring fence to get paid for hours which he had not even spent within the works. Under the present system, by which each man's time is checked and signed for by his foreman, there is probably much less "fence-jumping" done.

A workman has often temptations to "go slow" which are in the nature of physical discomforts. He is not likely to be doing his best when subjected to extremes of heat and cold, when he is insufficiently protected from wind and weather, when he is deprived of light, space, or ventilation, or when surrounded by dirt and litter. In the workshops of our most modern plants these facts have been thoroughly recognized; in the shops equipped with mechanical heating and ventilating appliances, ample window areas, electric light, sufficient floor space, and good cleansing, more economical results are undoubtedly being attained. On board vessels partially constructed or being fitted out these desiderata are not always so thoroughly attended to, but the principle is the same, and good lighting, cleansing, and access are quite practicable. The advantages of doing all external work as far as possible during the summer months, and of having decks laid, houses built, and shells completed for the protection of men working below during the winter, where the building slips are not roofed in, are of course perfectly obvious. In concluding this section, it may be remarked that work should be done as much as possible in places where the men may easily be seen and "hole and corner" work avoided.

4. *Reduction of overtime to the minimum limit.* The reasons for working overtime are usually perfectly comprehensible, but seldom cogent. The completion of a vessel may have been unavoidably delayed, and the pressure of the owners or the financial heads of the shipbuilding firm may induce a superintendent to employ this method of hastening the completion of the work against his own better judgment. Anxiety to produce rapid construction for favorable comparison with a rival organization engaged upon similar work is another cause,

but the most plausible reason is generally the desirability of hastening certain parts of the work which may have been delayed by the non-delivery of materials or an insufficiency of machinery or other plant facilities, in order to enable the succeeding operations to be pushed on.

Overtime is not only unprofitable from the fact that increased rates of wages have to be paid for it, but the output of a workman during the last three hours of a thirteen-hour day is almost invariably reduced, and if overtime becomes a regular thing he will soon be turning out no more in thirteen hours than he previously produced in ten. Workmen who wish to increase their weekly earnings by this means are sometimes to be met with, but they usually are clever enough to avoid overtaxing their physical resources in the process.

Means for limiting the amount of overtime work naturally suggest themselves from the causes which produce it. Placing orders for materials at the earliest possible date—especially for the kinds which may occupy months in manufacture—securing well-timed deliveries, commencing construction as soon as it can be proceeded with continuously, and good progress made in the early stages will prevent unnecessary haste later on. Overtime worked for the mere purpose of racing against rival constructors can only be excused on the grounds that victory means a valuable advertisement—and the value of the advertisement is questionable—or that the enthusiasm or *esprit de corps* of the personnel is stimulated by competition. The latter idea is known to be illusory by those who have personally balanced the weariness of long hours against their fraction of glory.

When, however, it really becomes necessary or advantageous to work overtime, certain checks are of value. A morning statement from the timekeeper of all overtime worked overnight is useful to the superintendent, while better progress is made if a responsible member of the staff is known to be about while the men are at work. In some plants all overtime is forbidden except upon the superintendent's personal instructions. Night-shift work is more economical, or less wasteful, than overtime when the work in hand exceeds the daily capacity of the machine tools, and under certain circumstances it is distinctly more economical to resort to this than to sink further capital in the plant.

5. *Piecework and premium systems* have invariably been originally introduced for purposes of economy; but while doubts are now sometimes expressed as to the economy of piecework, the immediate success which was claimed for the latter system when applied to machine work does not appear to have been followed up by any attempt to adapt it to the shipbuilding trades. After a few years' trial of piecework in the iron departments, some firms have experienced a special difficulty. Improvements to the plant are seen to be desirable, alterations are made, and the men's power of production thereby increased. Certain reductions in the prices paid now appear to be perfectly reasonable, but are strongly resented by the men, and compromise is often the result. If, however, the improvements are continued under such circumstances, it soon becomes perfectly obvious that the men have been getting the lion's share of the advantages, and, unless piecework prices are controlled with unusual ability, it scarcely pays to improve the facilities of an iron shed where work is done on piece.

In some yards pieceworkers have succeeded in earning such high daily averages that the work could apparently be carried out more cheaply on time wages. Good results have been shown in machine shops from the working of a premium system grafted to an existing time wages system. Areas to be machined multiplied by suitable constants were found to give good approximations to the number of hours that the machinist would occupy on the job at time wages, and he was notified that half the hours he saved on the time so computed would be added to his week's time account.

Since contract prices may be made for piecework ironwork, the number of hours that jobs should occupy may be estimated. It does not, therefore, appear impossible to adapt the premium system for shipfitting, but the desirability of such an adaptation naturally depends upon various circumstances and local conditions.

Without entering fully into the subject of premium systems, it may be said that they have already shown economical results, and may be the means of effecting some of the shipyard economies of the future. The following suggest themselves as possible fields for the introduction of this system.

(*a*) Shop joiner work.

(*b*) Fitting up state rooms and store rooms in merchant vesels.

(*c*) Fitting up shell rooms, magazines, and store rooms in warships, as well as:

(*d*) Shipfitting.

(*e*) Anglesmith work.

(*f*) Blacksmith work.

6. *Abolition of timework for squaring up piecework* may be dismissed with little more than a reference, for, although in a few plants abuses have arisen in busy times from the fact that pieceworkers will generally take every advantage they can in the matter of leaving their work incomplete, in dull times like the present, proper completion can easily be insisted upon.

7. *Time rates* of wages in this country are admittedly much in excess of those ruling in Europe, and, in some cases, outside demand has resulted in curious inequalities between the maximum rates paid to skilled men in different trades. While wages cannot be expected to come down to the European level, what possibilities there are of making reductions must of course be taken advantage of in dull times or not at all. From the employer's point of view it is, no doubt, good policy to encourage as many young men as possible to enter the various trades for the purpose of qualifying as skilled operatives.

8. *Economy in finish* is well understood in America, and can be attained without any detriment to the essentials, not only by avoiding hand labor wherever machine work will serve the purpose, but also by employing the cheapest materials which are suitable and satisfactory; and these considerations are as important in vessels requiring the highest finish as in the cheaper types of ships.

Modern wood-working machinery will now produce work so nearly complete that little more than the glueing up has to be done by hand, but care requires to be taken that, in designing and arranging the details of the

joiner work, the range of operations which the existing machinery is capable of is utilized to the fullest extent.

This economy in finish which depends upon detail design is also to be looked for in work produced by other departments, and much more ingenuity is shown by some shipyards in this respect than by others.

The following directions were posted in one drawing room and are of interest in this connection:

Don't use composition where cast steel or wrought iron will serve.

Don't use cast steel or wrought iron where cast iron will serve.

Don't draw out a new pattern if an old one will serve.

Don't order hand forgings if you can use drop forgings.

Don't finish anything that can be left rough.

Don't finish anything by hand that can be arranged for machining.

Don't forget lubrication and save weight.

The following are a few examples of economies which are not by any means general yet:

The use of the emery wheel for cleaning up forgings and castings where the chisel and file were formerly used.

The use of the buff wheel for polishing stanchions and other brasswork, to the exclusion of lathe work and hand filing.

Use of malleable cast iron and spelter collars for bulb beams passing through steel superstructure deck houses.

Extended use of special products, such as hydraulically embossed papier maché, wood, leather, etc., to replace hand-carved work for interior decoration.

LABOR CONTROL.

1. *Proportioning the numbers and timing the operations of the various gangs of men so as to prevent delays* is a most important matter in shipbuilding, since the progress of so much of the work depends entirely upon the completion of what has gone before, and both foresight and experience are required for success. When, however, a firm is doing work of a more or less settled type, the records of a previous vessel will provide very useful information for a succeeding one if properly kept. The essential points are that the daily returns of the timekeeper must be properly classified in the labor records for each vessel, and that progress records must be kept in connection with the labor records.

As an example of one method by which this may be effected, the machinist labor on a battleship was daily reported under the following sections:

(*a*) Pumping, flooding, drainage, and ventilation.

(*b*) Turret, casemate, gun, and ammunition hoist fittings.

(*c*) Water-tight and air-tight doors, shutters, and manholes, and gearing up to main deck.

(*d*) Hatchways, shutters, skylights, etc., above main deck, and general shipfittings.

(*e*) Shopwork.

As each of these sections, except the last, was looked after by a separate foreman, each was provided with a properly drawn up summary of his work, arranged so that dates could be written in for the commencement and completion of each item. Percentage records could thus be easily obtained each week of all progress made, for comparison with the labor expended to date.

2. *Arranging the work so that progress made by one gang or individual workman can be checked off against that made by others* gives the men the incentive of competition, and can often be easily arranged for by a little foresight. Laying wood decks and hold ceilings, finishing state rooms, water testing compartments, fitting water-tight and other doors, shutters, and hatches, and fitting launching ways and packing, are some examples of work which may be thus arranged.

3. *Under foremen and leading men* carry out work which may not be a very heavy tax upon their intelligence, but since successful shipbuilding largely depends upon the efficient control by these men of the operatives, they must not only be carefully selected, but kept thoroughly informed by plans, lists, and daily notes. It is neither possible nor desirable to give an under foreman complete schedules and information regarding his work on a ship at the outset, but it is absolutely necessary to keep him posted well in advance and have the materials ready for him as he requires them. He can always be given a completion date to work to, and the combined labor and progress records before alluded to quickly show if progress is unsatisfactory.

Leading men are always used, officially or unofficially, by under-foremen who have charge of upward of 30 men. Official recognition of this by a slight advance in wages establishes a system by means of which men are put into training to become under-foremen, and which provides retiring positions for under-foremen in dull times.

(To be continued.)

Paper for Printing Blue Lines on White Ground.

The following process, credited to Captain Abney, yields a photographic paper giving blue lines on a white ground:

Common salt	3 ounces
Ferric chloride	8 ounces
Tartaric acid	3 1-4 ounces
Acacia	25 ounces
Water	100 ounces

Dissolve the acacia in half the water, and dissolve the other ingredients in the other half; then mix.

The liquid is applied with a brush to strongly-sized and well-rolled paper in a subdued light. The coating should be as even as possible. The paper should be dried rapidly to prevent the solution sinking into its pores. When dry, the paper is ready for exposure.

In sunlight one or two minutes are generally sufficient to give an image, while in a dull light as much as an hour is necessary.

To develop the print, it is floated, immediately after leaving the printing frame, upon a saturated solution of potassium ferrocyanide. None of the developing solution should be allowed to reach the back. The development is usually complete in less than a minute. The paper may be lifted off the solution when the face is wetted, the development proceeding with that which adheres to the print. A blue coloration of the background shows insufficient exposure; and pale blue, over-exposure.

When the development is complete, the print is floated on clean water, and after two or three minutes is placed in a bath made as follows:

Sulphuric acid	3 ounces
Hydrochloric acid	8 ounces
Water	100 ounces

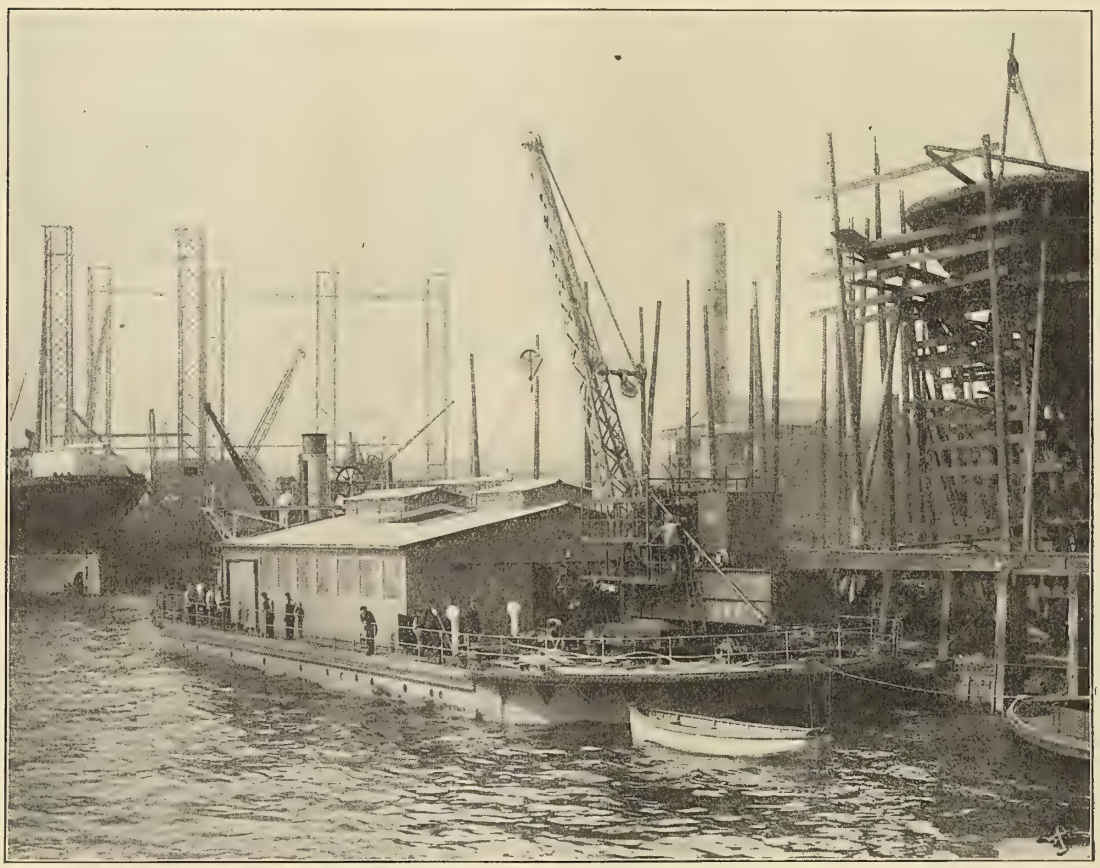
In about ten minutes the acid will have removed all iron salts not turned into the blue compound. It is next thoroughly washed and dried. Blue spots may be removed by a 4 per cent. solution of caustic potash.

The back of the tracing must be placed in contact with the sensitive surface.—*Drug. Circ. and Chem. Gaz.*

A Floating Workshop.

In an English shipyard there has recently been completed a floating workshop for use in Durban harbor, South Africa. The vessel is expected to be used chiefly in repairs to steamers as they lie at anchor or in dock, for the craft can proceed directly to the vessel.

The workshop was built at the yard of Swan and Hunter, the builders of the Durban floating dry-dock, and was docked by the latter, and both will be towed to their destination at Durban. The workshop float is 129 feet 3 inches long, 40 feet wide inside of fenders, and 8 feet 4 inches molded depth. Although, as seen in the illustration, the ends are very bluff, yet on her trial trip a speed of 7.12 knots was obtained. The craft is propelled by two screws, each driven by a compound condensing engine with cylinders 12 and 26 inches by 15 inches stroke. A Scotch boiler supplies steam at 130 pounds pressure. The workshop is erected on the deck and contains the following tools: A screw-cutting gap lathe, 10 inches centers and 15 feet bed, admitting 9 feet 6 inches between centers and 3 feet 4 inches by 12 inches in the gap; a shaping machine with a maximum drilling and tapping machine, and a 5-foot radial drilling machine; a 3-cwt. steam hammer on a special foundation, and a punching and shearing machine which will punch 1-inch holes in 1-inch steel plate and shear plates of the same thickness, angles, etc. There are also two fixed smith fires and a portable fire, and a slab for leveling. A 3-inch pipe-screwing machine is also found in this commodious workshop. The tools are driven electrically by motors; a reserve of 10 horse power has been provided for additional tools that may be added from time to time. The vessel is lighted electrically from the same generating plant, which consists of a 6-pole dynamo giving 300 amperes at 110 volts at a speed of 320, cylinders 8 1-2 and 14 1-2 by 9 inches stroke. There are six motors, one to each machine, only the fan and grindstone being belt-driven.



FLOATING WORKSHOP FOR SOUTH AFRICAN HARBOR.

On the forward deck is a 40-ton cantilever crane with 40-foot span, which is expected to be of service in harbor work as well as in ship-repair work. The ship is well lighted by large windows at the sides, and ventilation is secured through the roof, which is also fitted with a large hatch. There are also accommodations for six Europeans and ten natives.

In the hold is abundant space for supplies of all kinds, and in the bunkers on either side of the boiler 38 tons of coal can be stored. The fresh-water tanks hold about 20 tons.

INTERNAL-COMBUSTION MOTORS FOR CANAL-BOAT TRACTION.*

BY JULIUS KUSTER.

There seems to be promise of a wide field of usefulness for the internal-combustion motor in the propulsion of motor canal boats. Of first importance in this respect is the economy which the new types of motor offer in comparison with that of the steam engine, and which in this respect seems to give the combustion motor an important point of relative advantage.

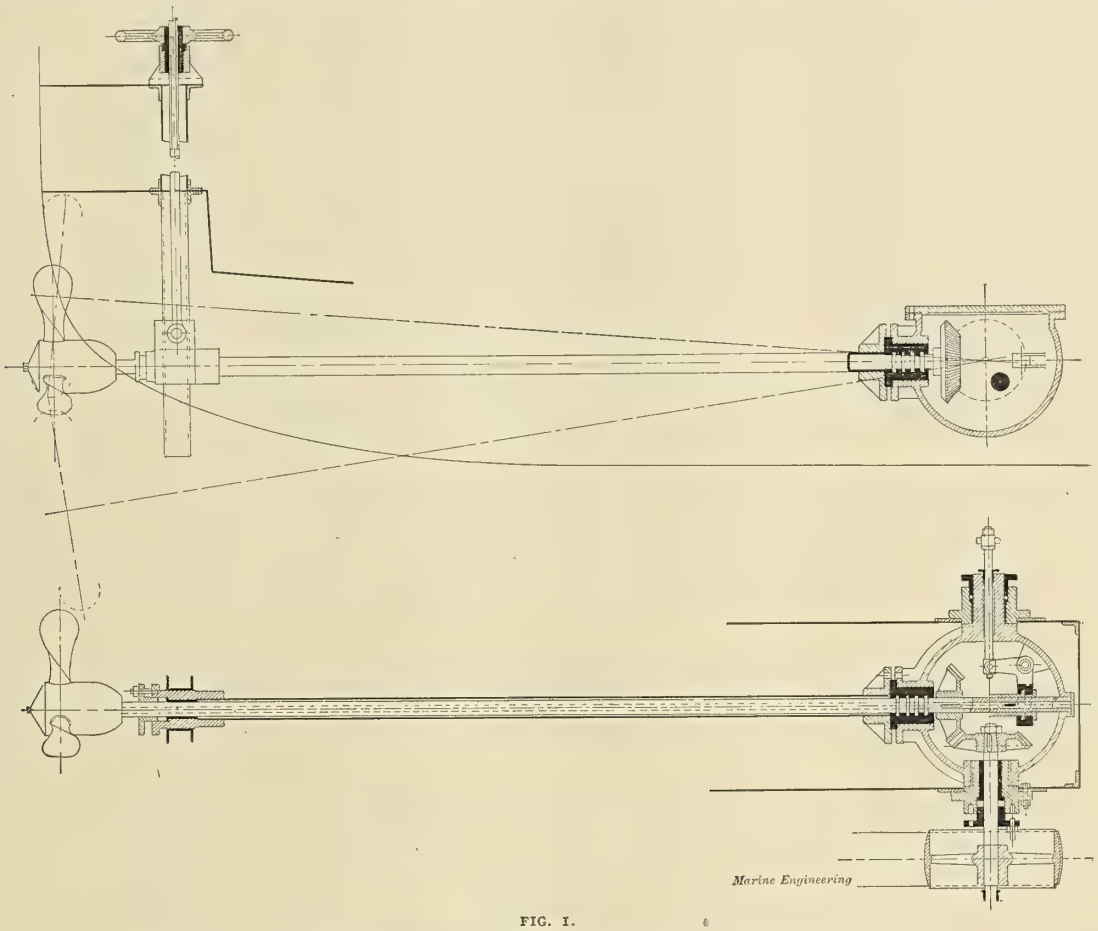


FIG. 1.

Before we proceed, however, with the development of the Deutzer boat motor in relation to its application to canal-boat propulsion, it may be of interest to glance briefly over the various methods which have hitherto been attempted for the mechanical propulsion of canal boats.

More than twenty years ago there existed a commercial demand for some type of steam canal boat, but at the time such craft had not become in any manner definitely adapted to such special purpose. It was found that the weight of the steam boiler and engine, under the conditions existing, reduced seriously the available capacity for cargo, and also that much damage resulted to the banks of the canal from the waves developed by the propulsion of the boats at the speeds attempted. In the commercial waterways between Magdeburg, Berlin, and Stettin are still to be found a limited number of fast steam canal boats, although this type of carrier has lost clearly 20 per cent. of cargo capacity by reason of the necessary equipment of machinery and boilers. In order to make good this loss the attempt was soon made to transfer the motive power to the land, as in the case of horse traction so long used, and thus there were introduced at an early date steam locomotives which towed the boats by a suitable arrangement of cable. However, on the Oder-Spree canal, as also in France, it has been found that this form of traction cannot successfully rival that by horses.

Also the centralization of the mechanical installation in connection with a single towline for several canal boats gave rise to serious difficulty in connection with the necessary management of the lines.

It is natural, in the early years of the development of electricity, that this source should have been thought of as a means of propulsion for canal boats. The first efforts also naturally took the form of electric trolley lines along the banks of the canal, since storage batteries soon demonstrated their lack of adaptation to the demands of such service. The use of such lines along the canal called again for a choice between the installation of electric motors on the boat or on a truck running on tracks along the towpath of the canal. The results of the development of this system were, however, far from satisfactory. As the principal objection

*Translated for MARINE ENGINEERING from *Zeitschrift des Mitteleuropaischen Motorwagen-Vereins.*

it was recognized that the boat remained constantly dependent on a central source of power, and that every disturbance in the supply of power exercised a serious influence on the cost of operation. In consequence it was found necessary to have constantly ready for use a towing machine, and the frequency of demand in a canal which does a large business is exceedingly variable. It was found also that the towline passing from the boat to the bank, especially in the night and in connection with the meeting and passing of deeply-laden boats, was found to be the source of serious hindrance and trouble. Furthermore, an electric towing locomotive adequate for such demands could only be made to pay on a canal with a volume of traffic not less than one million tons yearly, and this figure is but rarely reached, and in addition it was found that no urging could induce the boatmen to utilize their horses as well.

So in the end, as the use of both steam boiler and steam engine, either on the boats themselves or by any form of distribution from a central station, seemed to prove unsuitable, attention became concentrated on the internal-combustion motor. As this type seems adequate for all demands, as it requires no specially equipped engineer for its care, as it takes but little from the carrying capacity of the boat, so must the cost of operation through the installation of such type of motors become materially reduced.

Attention must also be paid to a further consideration: the protection of the canal bed and banks from injury by washing. These latter conditions the Deutzer Gas Motor Company have met by the use of a propeller carried on a shaft which may be elevated or depressed, according as the conditions may demand. This is shown in Fig. 1 in vertical and horizontal plans and in part in section, and was first fitted in 1899. The same arrangement is now fitted with a reversing or adjustable blade propeller.

In order to make possible the elevation and depression of the propeller with the stern tube, the latter is made capable of rotation about a horizontal transverse shaft. About the latter is a spherical casing containing a bearing for the drive shaft, which gears to the forward end of the propeller shaft through a pair of bevel gears. This casing also carries in its central line on the opposite side the necessary connections for controlling and setting the adjustable blades of the propeller. To the outer end of the transverse shaft is attached a belt wheel. Attached to the casing on the after side is also the propeller-shaft stuffing box. The gear wheels and bearings can be kept flooded with oil by reason of the water-tight construction of the casing. At the after end of the shaft casing the stuffing box is carried in a vertical guide, and through suitable connections it may be elevated or lowered, even when the machinery is in operation.

The chief purpose of this adjustable screw shaft is to provide for a continuously uniform immersion of the propeller, whether the boat is deep or only light laden. In the case of the canal boats, as shown in Fig. 2, one propeller is provided with vertical adjustment, while two at the side are installed with fixed location, and both of the two latter, or the middle propeller alone, may by suitable belt connections be operated by one and the same combustion motor. The operation of the middle propeller follows naturally through the above-described gear casing and connections. In the case of a light boat the middle propeller is adjusted in its lowest position, as shown, while the two side propellers in such case will scarcely touch the water. In the case of deep load the middle propeller is raised to its highest adjustment, while the two side propellers, now fully immersed, are connected with the motor and serve to propel the boat. The motor is of 16 H. P., and with this power in free water a speed of a little over two miles per hour with 270 tons load has been attained.

In order to bring about greater simplification a later boat was fitted with but one central adjustable propeller. This adjustable propeller operates as well under light condition as under full load. In this case, furthermore, the propeller was of three blades, in order that the blades might be made reversible for backing and going ahead without reversing the motor.

The second point of importance, as noted above, regarding the propulsion of canal boats with combustion motors rather than with steam power, relates to the practicability of a producer gas installation. Such means for the development of power are not readily applicable to the demands of the automobile, and can scarcely expect to receive serious attention from those chiefly concerned with this particular field for combustion motors. This is not the case, however, for boat propulsion, and its possible applications in this direction merit therefore careful attention.

The methods which have been mostly in use for the past fifteen years for the generation of "producer" gas have involved the passage of a blast of steam and air through glowing coal. With such an equipment a steam boiler and holder for the gas was requisite. These demand careful supervision, and the space required is also very considerable. Through a great simplification in the methods of operation, however, the possibilities of this gas have recently received a new significance. Both boiler and special gas holder may be dispensed with, and the action of the piston within the cylinder on the entering stroke is found sufficient to form the vacuum in the pipes leading to the cylinder necessary to draw through glowing coal a charge of air laden with vapor, which thus automatically enters and fills the cylinder. The generator, which consists of a small roasting oven, contains in its upper part a water shell which is heated by the action of the gases themselves. The entering air thus becomes saturated with water vapor over the surface of this water, and is thus brought into the condition necessary for the formation of gas. Then by passage through a layer of glowing coal the gas becomes charged with carbon monoxide, thus providing the chief combustible component. Then, before admission to the motor, the gas is cooled and cleaned by passage through a water spray, thus clearing it of any dust or tar which it may contain. The gas, after being generated, is collected in a holder in the top, thus providing a reserve supply and a more uniform flow to the engine.

The feeding of the gas generator with coal is provided by a hopper placed conveniently over the oven, and the proportions are such that one filling of the hopper suffices for a considerable length of time.

In starting up the apparatus the necessary air blast must naturally be supplied by a hand-blowing device.

During this period the smoke and gases are led away through a funnel provided for the purpose.

furnace is filled with coal through a suitably-fitted chute leading from the deck above. The only remaining

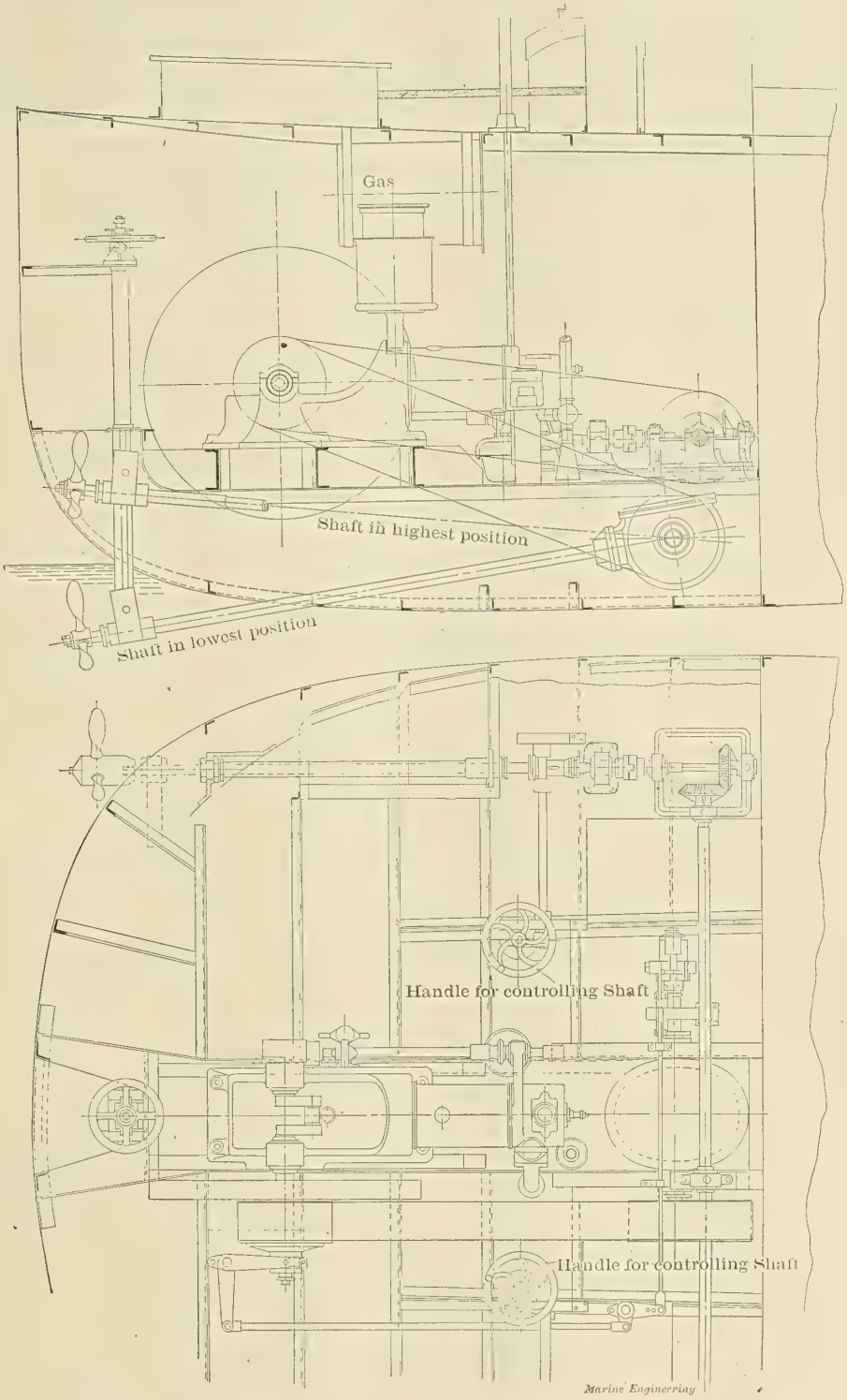


FIG. 2.

In the form of producer gas apparatus installed in the canal boat *Haldy I.*, mentioned above, the generator and gas holder stand at the side of the machinery space and the motor itself in the middle. The attention required is the occasional cleaning of the grate from ash and cinders.

The above-described type of installation for making producer gas is not, however, well adapted to small or

fine-formed boats. In such cases a somewhat different construction is preferable, especially as in such cases the available room at the stern may not be more than sufficient for the installation of the propeller. The carrying capacity of such boats will of course be reduced by especial fineness of form at the stern, but, nevertheless, such form is to be preferred by reason of the smaller stern wave which is produced by the passage of the boat through the water.

A third type of this producer gas apparatus is made suitable for use on river boats and where the installation of propeller shaft is of the usual character instead of adjustable, as in the cases above noted. The motor here illustrated is of the two-cylinder, balanced type, high speed, and of 40 horse power.

The especial advantage of the producer gas installation for river and canal boats consists primarily in the decrease of the cost of operation as compared with combustion motors using benzine, petroleum, or wood alcohol. In Holland the two latter can be obtained in quantity, since there is no impost; but in Germany and France the expense of such mode of operation would be prohibitive. If we take, for example, an ordinary type of river steamer of, say, 275 tons, and with a speed of about two miles per hour, requiring seven to eight horse power per mile hour, then in Germany or France the cost of such a mode of propulsion with spirit or gasoline would reach from 16 to 20 cents per mile hour. Adding to this the necessary fixed charges and there would remain very slight advantage in comparison with the use of horses. With producer gas, and an installation similar to those above described, these figures would fall to from 2.5 to 3.7 cents. Including fixed charges, in the case of the canal boat *Haldy I.*, mentioned above, the cost per mile is from 6 to 7.5 cents, or from 2.5 to 3 cents per ton mile. While with such small power the operation expenses with a steam boiler and engine outfit would be not less than the higher figures quoted above, such is not the case with the producer gas outfit, and on account of its great simplicity and adaptation to the requirements of the situation, it would appear to have solid points of advantage for service of this character.

Data Cards.

The following cards are made up from data found in two papers read at the recent annual meeting of the Society of Naval Architects and Marine Engineers. The *Noma* was described in a paper presented by Mr. Clinton H. Crane, and the *Minnesota* in another paper by Mr. Charles R. Hanscom. Both of these papers were accompanied by drawings of the vessels.

NAME—Noma.	NATIONALITY—American.	TYPE—Steam yacht.
LAUNCHED—1903.	DESIGNER—Tams, Lemoine and Crane.	BUILDER—Burlee Dry Dock Co.

Length over all	252 ft. 0 ins.
" load water line	226 " 0 "
Beam	28 " 5 "
Depth	18 " 3 1-4 "
Draft, aft	14 " 0 "
" forward	12 " 0 "
Displacement on trial	1,035 tons
Prismatic coefficient	.601
Speed on trial	19.06 knots
Bunker capacity	230 tons
Coal on trial	150 "
Fresh-water capacity	12,500 gals.
Engine—4-cylinder, triple-expansion	
Cylinder diams.—17, 27, 32, and 32 ins.	
Stroke	24 "
Revolutions, trial	205
I. H. P., "	4,200
Propellers	2, three-bladed
Diameter	9 ft. 0 ins.
Pitch	11 " 0 "
Boilers: Number	6
Type	Almy water tube
H. S.	9,595 sq. ft.
G. S.	221 " "
Area of boiler floor space	600 " "
Forced draft, closed stokehold, air pressure	2 1-2 ins.
Blowers, number	3
Diameter	54 ins.
Revolutions	500
Width at tips	20 ins.
H. S. ÷ G. S.	45.
H. S. ÷ I. H. P.	2.36
I. H. P. ÷ G. S.	19.0

NAME—Minnesota.	NATIONALITY—American.	TYPE—Ocean passenger and freight.
LAUNCHED—1903.	BUILDER—Eastern Shipbuilding Co.	OWNER—Great Northern Steamship Company.

Length over all	630 ft. 0 ins.
" between perps	608 " 0 "
Beam, extreme	73 " 6 "
Depth, from bottom of keel to upper navigating bridge	88 " 3 3-4 "
Depth, from bottom of keel to upper deck center	56 " 1 in.
Water ballast, total	5,072 tons
Coal bunker, total capacity	6,156 "
Dead-weight cargo capacity, excluding reserve coal bunker	30,000 "
Total stores	250 "
Draft, load	33 ft.
Corresponding displacement	33,000 tons
Block coef.	.761
Prismatic coef.	.8
Launching draft, aft	14 ft. 10 ins.
" " forward	10 " 6 "
" weight	about 11,000 tons
Ground ways, distance bet. centers	25 ft. 6 ins.
Length over all	810 " 0 "
" beyond stern post	235 " 9 "
Width	5 " 4 "
" where fore poppet presses	6 " 0 "
Declivity per foot	.636 inch
Sliding ways, length	550 ft. 9 ins
Width	4 " 6 "
Area	4,960 sq. ft.
Declivity of keel per foot	.54 in.
Pressure per square foot of fore poppet	13 tons
Water over end of ways	10 ft. 11 ins.

Manufacture of Seamless Cold-Drawn Steel Boiler Tubes.

BY G. M. KOHLER, ASST. ENGINEER, U.S.R.C.S.

Very few sea-going engineers have ever had the opportunity of witnessing the manufacture of seamless boiler tubes. It is for the benefit of those who have never had this opportunity that this article is written.

A seamless tube is one that is made from a solid piece of steel, or "billet," as it is called. These billets are open-hearth basic steel and show approximately the following analysis: carbon, .17 per cent.; manganese, .45 per cent.; sulphur, .025 per cent.; phosphorus, .10 per cent. Steel having more than .18 per cent. carbon is not used.

The material is received from the steel mills in solid pieces about ten feet long and four or five inches in diameter. The first step in the manufacture of the tube is to cut these long bars into smaller pieces of such length as to contain enough metal to make one tube of the required size. A piece about 18 inches long and 5 inches diameter will make a 3 1-2-inch tube about 14 feet long. These small pieces or billets are cut from the long bars, either hot or cold, by means of saws.

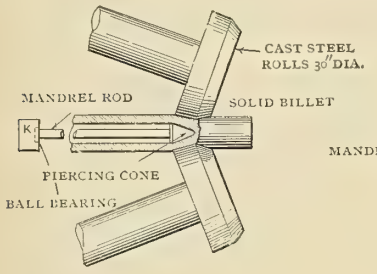


FIG. 1

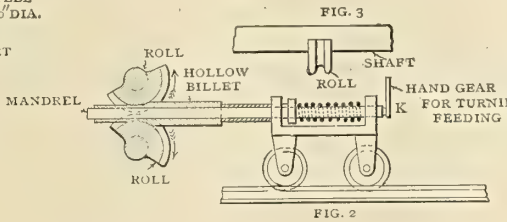


FIG. 2

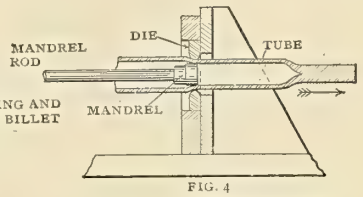


FIG. 4
Marine Engineering

It requires about sixteen minutes to cut a 5-inch diameter bar when cold and a much shorter time if the bar be heated to a cherry red. These saws are of the best steel suited for the purpose, and one saw will run about 18 hours without being sharpened. Some mills cut the billet from the bar by the use of a steam hammer and knife; this method, while being very quick and cheap, leaves the end of the billet rough and ragged, causing the end of the tube after drawing to be of poor quality and unfit for use.

After the billets are cut they are taken to a drill press, where a 1-inch hole is drilled in the center of one end to a depth of about one-half inch. This hole is for the purpose of centering the piercing cone in the piercing mill.

PIERCING THE BILLETS.

The most interesting part in the manufacture of the tubes is the piercing of the solid billets. After they are centered in the drill press they are placed in a gas furnace made of fire brick and rectangular in shape. The fuel used is gas obtained from the distillation of bituminous coal. These furnaces are so arranged that the billets enter the coolest part and gradually roll to the hottest part. This is for the purpose of slowly heating the billet so as to have it of the same temperature throughout. It requires about three hours for the billet to pass through the furnace, at the end of which time it is at a bright-yellow heat and is ready for the piercing mill.

This mill pierces a hole through the billet longitudinally, and at the same time increases its length about 100 per cent. As shown in Fig. 1, the piercing mill consists of two large cast-steel disks, about 30 inches in diameter and 16 inches thick, which revolve at about 100 revolutions per minute. The piercing cone fits loosely on a mandrel which is free to turn and is fitted in a ball-bearing socket at the end *K*. This bearing takes up the thrust due to the disks forcing the solid billet over the piercing cone. The thrust is very large, and if it were not for the ball bearing the mandrel and piercing cone would not revolve, as they would be held from doing so by the friction at the end of the rod.

When the billet is taken from the furnace at a yellow heat it is placed in a guide, such that it enters between the disks, as shown, in the same plane as the axis of the shafts which revolve the disks; the piercing cone then enters the center of the billet and in the small hole which was drilled for this purpose. As soon as the billet comes in contact with the revolving disks it is given their circular motion and at the same time thrust forward by them over the piercing cone. This thrust is of the same nature as that which causes a belt to climb to the highest part of a revolving pulley. After each billet is pierced the cone and mandrel are thrown into cold water and allowed to cool; a stream of water is also turned on the disks for the same purpose.

ROLLING THE HOLLOW BILLETS.

The billet, which is now known as a hollow billet, and is still at a good yellow heat, is now ready to be rolled to reduce the thickness of the walls and at the same time to increase its length. The rolling is carried out to such an extent that the tube is about 1-2 inch larger in diameter and about five gauges B. W. G. thicker than the finished tube. There are two different methods of rolling. Some mills use the ordinary cast-iron rolls, the tube being placed on a mandrel whose point is held between the rolls. The tube is given about six to eight passes through the rolls, care being taken that it is turned through 90 degrees after each pass, so that the walls may be rolled of even thickness throughout its entire length.

A somewhat different method of rolling is roughly illustrated by Fig. 2, from which it is seen that there are two semi-circular rolls, each forged on a shaft. These rolls are about 24 inches in diameter, and are grooved as shown in Fig. 3. The hollow billet, as soon as it comes from the piercing mill, is placed on a mandrel,

the end of which is then inserted into a socket and carried on a truck. The truck is then pushed forward until the end of the mandrel and billet comes between the rolls. The rolls revolve in the direction shown by the arrows, which tends to thrust the billet out from under the rolls. To overcome this the socket in which the mandrel is secured is fitted with helical springs, which are compressed when the rolls push the billet out. As soon as the rolls leave the billet the energy which is stored in the springs pushes it back, so that by the time the rolls come around again the billet is back in its proper position under the rolls. As the billet is rolled out it must be fed under the rolls, and also turned on its axis to prevent uneven rolling. For both of these purposes there is a suitable hand gear located as shown.

The tube is now about six to eight times the length of the original billet. The inside of the tube is smooth and free from scale, but the outside has considerable scale on it. The tubes are allowed to cool in the open air, after which one end is heated in a gas furnace, then taken out and pointed under a small steam hammer: this point is about one foot long and serves as gripping surface for the pliers on the cold-drawing benches. To remove the scale the tubes are sent to the pickling room and immersed in a solution of sulphuric acid. After the scale has been loosened up the tubes are rinsed off with water, then placed in another tank containing a mixture of tallow, flour, and warm water. This operation is called "doping." They are left in the doping tank for about one-half hour; then they are dried and are ready for the first pass on the cold-drawing bench.

COLD DRAWING.

Fig. 4 illustrates the principle involved, from which it is seen that one end of the tube is open and the other closed or pointed. As stated above, this point is for the purpose of gripping the tube by the pliers which pull it through the die. The mandrel is carried on the end of a long rod, the end of which is fastened to the end of the draw bench. After the mandrel is placed in the tube the pointed end of the tube is passed through the die and the drawing pliers made to grip it. By a suitable connection with an endless chain, the pliers draw the tube slowly through the die (about nine to twelve feet per minute). As the tube passes through the die it is reduced in thickness and diameter and also lengthened about 20 per cent.

The cold drawing of the tube causes the metal to become brittle, so that after each pass it is found necessary to anneal and dope them. To anneal them they are heated to a cherry red in an oven, then allowed to gradually cool in the open air. They are then doped again and given another pass at the cold-drawing benches.

The number of cold passes given to the tube depends upon, first, the strength of the mandrel rod; second, the strength of the material in the tube; third, the thickness of the walls of the tube. From Fig. 4 it is clear that, in drawing, the pliers tend to pull the tube apart at the die; also, the mandrel rod tends to come through the die, due to the friction between the metal of the tube and the mandrel; hence the pull of the pliers must not equal the tensile strength of the tube or the mandrel rod. It usually requires about three passes on the cold drawing bench, though for tubes with thin walls twice this number of passes may be necessary.

After the tubes are finished in the bench room the pointed end is cut off in a lathe and this end of the tube gauged for thickness. If the walls are of the proper thickness and concentric, the tube is cut to length and gauged at the end last cut off.

The surface of the tube as it comes from the cold-drawing benches is very smooth, almost polished, but the metal, as stated above, is hard and brittle, requiring a final annealing. This is carried out in closed sheet-iron retorts, about 14 inches in diameter and about 25 feet long, with the ends fitted with cast-iron headers. The tubes are placed in the retorts, the ends closed, and the retort then pulled into a long, rectangular furnace. About every twenty minutes the retort is turned around 90 degrees by rolling it toward the other end of the furnace; finally, about two or three hours after it first entered, when the tubes are at a cherry-red heat, the retort reaches the other end of the furnace and is taken out and allowed to cool for about 12 hours. The tubes are then removed from the retort.

The tubes after being annealed are very crooked and need to be straightened. This is done by supporting the tube, with curved part upward, on two grooved rollers about five feet apart; between these rollers is a die working vertically, which, as it descends, forces the curved part of the tube downward; the tube is moved along the rollers, and, by repeated operations of the die, is made perfectly straight.

Record Long-Distance Run.—The steamship *Texan,* of the American-Hawaiian Steamship Company, arrived at Philadelphia from the Pacific on November 17. She left Tacoma on September 21 and steamed 14,100 miles without coaling or entering a port, the first voyage of this kind ever sailed. The *Texan* was in charge of Captain D. D. Morrison, and John L. MacVicar was chief engineer. Passing through the Straits of Magellan two stops were made to wait for daylight, but these were the only ones on the entire voyage.

Steamship Manchuria.—The steamship *Manchuria,* which stuck on the ways on October 31, was finally launched on November 2 from the yard of the New York Shipbuilding Company, Camden, N. J. The *Manchuria* is a sister ship to the *Mongolia,* launched from the same yard on July 25, and is for the transpacific service of the Pacific Mail Steamship Company. These two ships were originally ordered by the Atlantic Transport Line, but were later sold to the present owners. Each is 600 feet between perpendiculars, 65 feet beam, and 51 feet depth, the displacement being 26,530 tons, and the dead-weight carrying capacity 14,000 tons. The vessels have four complete steel decks and a bridge house amidships. The rig is that of a four-masted schooner with one smokestack. Special arrangements have been made for the rapid handling of cargoes. Accommodations are provided for 350 first-class passengers, 68 second-class, 1,300 steerage, and a crew of 216. Twin-screw, triple-expansion engines are installed, with a designed horse power of 12,000, which should give the ship a speed of 16 knots. Steam is supplied by four double-end and four single-end Scotch boilers.

NOTES ON THE ARRANGEMENT AND CONSTRUCTION OF STEAM PIPES AND THEIR CONNECTIONS.*

BY ROBERT C. MONTEAGLE.

The principal object of this paper is, first, to point out and emphasize some of the causes of failure of steam pipes, and, second, to describe some points in the general design, as well as material entering into the construction of steam pipes, which go far to insure their integrity under the most severe conditions of service. The subject is one which is becoming more important every year, owing to the rapidly increasing steam pressures which are coming into such general use. The causes of failure in steam pipes may be classified as follows: first, faulty design; second, bad workmanship; and, third, defective material. The first of these, viz., faulty design in some one of its many and varied forms, is in evidence in a remarkably large percentage of vessels. One of these forms of faulty design is in the employment of copper for pressures exceeding, say, 150 pounds per square inch. Owing to the number of accidents occurring with copper steam pipes, this material is being used less frequently in each succeeding year. The elastic limit of good sheet copper is reached at from 5,300 to 5,600 pounds per square inch, and the ultimate tensile strength about 30,000 pounds per square inch In good steel pipe the elastic limit reaches from 30,000 to 35,000 pounds per square inch, and the tensile strength 53,000 to 60,000 pounds per square inch. These figures alone demonstrate the hopeless inferiority of copper for use in steam pipes as against steel. It may be accepted as a fact, also, that copper in the vicinity of brazing is more or less injured by the heating, and in some cases by the overheating, which they are subjected to; yet where copper steam pipes, say six inches in diameter and over, are used, the best practice is to "make them up." My reasons for so stating are that solid-drawn copper piping of such diameter and the necessary thickness required is almost invariably of a non-uniform thickness, and frequently possesses the undesirable characteristic or tendency to split longitudinally.

This characteristic, it may be noted, seldom develops at the original time of testing, and hence its extreme danger. On the other hand, brazed copper piping never can possess the same strength as the original sheet from which it was made, even granting that the workmanship is exceptionally good. Rules are given for determining the thickness of copper to be used in steam pipes, in the pamphlet issued by the Board of Supervising Inspectors of Steam Vessels, but which do not state that such thickness should be increased where bends occur. Almost any engineer is familiar with this requirement, but unfortunately there are individuals who deem it good practice to elude their duty when presented in this or other similar form. It is, therefore, important that this requirement be embodied in the said rules. A better rule would be to *prohibit the use of copper* for steam pipes which are subjected to pressures exceeding, say, 150 pounds per square inch, and which exceed, say, 3 inches in diameter. A glaring error which has been perpetuated from one edition to another in this pamphlet is where this phrase occurs: "The flanges of all copper steam pipes over 3 inches in diameter shall be made of *bronze or brass composition,* shall be securely brazed to pipe," etc. This of course should read "brazing metal." Another form of faulty design is frequently found in the method of allowance for expansion. The two ordinary methods are illustrated in Fig. 1 and Fig. 4. The method at Fig. 1 has the drawback of being unbalanced, and therefore must be furnished with "preventer bolts" so that the sleeve may not be forced out of place by the unbalanced pressure. The adjustment of these bolts must be accurately made, or an undue strain will be brought on the piping, either when steam is turned on or when the piping is cold. The other method, at Fig. 4, is a simple dependence on the flexibility of the piping itself to take up the expansion. With piping, say, 3 inches in diameter and over, this is not good practice, as the metal will become crystalized after constant working, and is liable to crack or break at the most rigid point. This class of accidents has in various cases been fatal.

Another form of faulty design, and a common one, is in the formation of depressions, however slight, in the piping, or, in other words, dropping from one plane to a lower, and rising to the original plane again. When steam is turned on the body of water which has collected in this depression is set in motion, and carried to the engine, where damage is done or excessive strains set up. In any case, separators of ample capacity should be placed near the engine, so that they may collect any water in the pipes. An efficient separator is very desirable, as the entrainment of water by steam traveling at high velocities is always a source of anxiety to engineers. It is absolutely certain that after entrainment of water takes place, no possible arrangement of piping can be made to carry such water back to the boiler without the intervention of an efficient separator. A method which will somewhat mitigate this evil is to superheat the steam as it leaves the boiler; and should the quantities of water carried over not be too great, this will possibly obviate the trouble. Objections to superheated steam are, however, great enough to rule this method out with the majority of engineers.

The second division, as classified, of the causes of failure of steam pipes is *bad workmanship.* This may be subdivided again into bad workmanship at the mill, and bad workmanship by the coppersmith or pipe fitter who puts the piping in place. Bad workmanship at the mill is beyond the control of the users of steam pipe, whether that pipe be made of copper or of steel, and the following remarks are equally applicable to the manufacture of both kinds of pipe. It is nothing short of criminal on the part of the manufacturer of piping to neglect taking all the precautions possible to inspect the material before, during, and after the process of manufacture. Possibly this is done, but I regret to state that such is not my belief. On the contrary, my belief is that inspection at the mill is not rigid enough, and that is why we have some of our failures of steam pipes.

The builder of a steam vessel, who installs all machinery, makes all connections, etc., is held responsible for this machinery, piping, etc., until the vessel is de-

*Read at the eleventh general meeting of the Society of Naval Architects and Marine Engineers, held in New York, November 19 and 20, 1903.

livered, and frequently for a much longer time. Should any part of the piping fail, possibly causing loss of life, the builder is held responsible. Does this not seem unjust? Providing that the fault be in defective piping, the onus of blame should be placed on the manufacturer of the pipe, and he should be obliged to pay for the damage done. This method, if enforced, would undoubtedly have the desired effect of better inspection at the mill and the production of better piping. Regarding bad workmanship by the coppersmith, it has been my observation that the greatest number of cases of bad workmanship in copper piping are directly connected with the brazing of flanges to pipes. The copper is frequently injured by excessive heating. To what extent the tensile strength of the copper is lessened by such bad workmanship it is very difficult to ascertain, but when such cases are discovered, however slight the burn, it is imperative to condemn the work. The heavier copper piping is, the greater danger there is from "burning" during the process of brazing joints, and hence further danger in its use for high steam pressures. The fitting of steam pipes of all kinds is a very important matter. Through the careless work or bad judgment of pipe fitters, strains are brought on piping which are a constant source of danger. Expansion may not be allowed for. Joints made up where flanges do not meet fairly. Proper allowance not made for gaskets. The making up of joints before vessels are launched and no allowance having been made for possible change of form. These are a few instances of bad judgment or carelessness of pipe fitters, and they might be multiplied. The inspection of this piping during the time of putting in place is therefore important, and should receive the constant attention of individuals who first of all possess the knowledge of what is required, and, secondly, whose duty it is to see personally that it is put in accordingly.

The third division, as classified, of the causes of failure of steam pipes is *defective material.* We may consider all material defective which fails to satisfy safely the necessary conditions of its use. The failure to comply with these conditions may be due inherently to the *quality* of the material or to the *kind* of material used. For the first of these we must hold the mill responsible, and for the second the designer. The material worked up into piping, whether of copper or steel, should be, and no doubt is, subjected to tests to prove its fitness for the purpose required. The question then arises: are these tests sufficiently severe to develop the possible fact of weakness or positive fracture? Should it not be made an absolute certainty at the mill that all steam piping shall stand the pressure for which it is intended? There is only one satisfactory method of doing this, and that is to subject each section of pipe to, say, not less than five times the working pressure required. As a matter of fact this is never done unless under direct instructions of the consignee. As before remarked, a characteristic or tendency to split longitudinally has been observed in solid-drawn copper piping of large diameter, when subjected to high pressures, and this tendency seldom exhibits itself at the initial test. Nevertheless, the initial test will undoubtedly develop an existing weakness in however small a degree, even though that weakness be not manifest. A second or a third test at the place where the piping is installed may then fairly be expected to cause fracture in piping which is inherently weak. All steam pipe which is "made up" by the coppersmith should be tested in the same manner and as many times. The fact that a pipe fractures under a water-test pressure should never be considered a misfortune, however much it may appear so. It is a warning to be heeded, and the interpretation of the warning is to insist upon having better material and better workmanship.

I may now briefly enumerate some points in the general design, as well as the material entering into the construction of steam pipes, which will practically in-

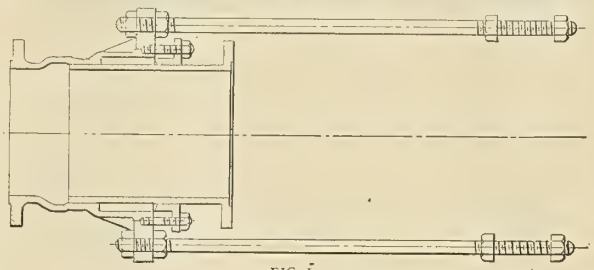


FIG. 1

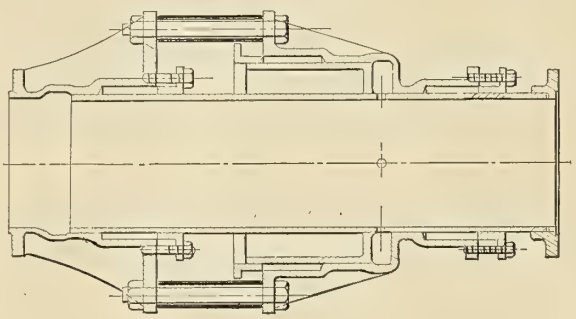


FIG. 2

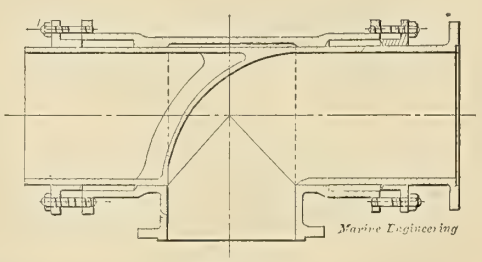


FIG. 3

sure their integrity under the most severe conditions of service, if properly put together. In making a general arrangement of steam pipes two requirements of vital importance should be borne in mind, viz., ample allowance for expansion must be made, and, if possible, there should be no pockets in the steam line. Permanent set will occur when metals are strained beyond the limits of their elasticity, hence the absolute necessity of proper attention to *expansion.* Should permanent set occur, it is only a matter of a short time till fracture takes place, due to the brittleness thus engendered. Metals of all kinds, subject to great variations of temperature and to varying strains, are constantly changing their molecular structure. In copper piping, therefore, where the elastic limit is so low, this should be neutralized by annealing the pipe at well-ad-

vised intervals. The weight of piping and connections should be carried by carefully-arranged hangers suspended from deck beams, spaced at frequent intervals. These should allow perfect freedom of movement, and at the same time be constructed so that the vibration will be absorbed.

An expansion joint made in either of the forms shown at Fig. 2 or Fig. 3 is a very satisfactory method of allowance for expansion, provided that there be a good packing in the stuffing box. It will be noted that either form is perfectly balanced. There are several good packings in the market for this purpose, but one notably so. This is a flexible metallic packing very much in use. Stuffing boxes for this purpose should be exceptionally deep, as it is not necessary then to pack them so tightly, and as a consequence a freer movement is permitted to the sleeve. The expansion joint shown at Fig. 2 has an enlargement cast on the sleeve. This forms a piston at the end of the sleeve adjacent to the casting having the large stuffing box. The end of this

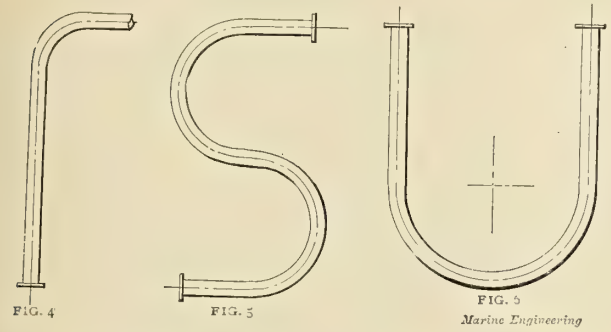


FIG. 4 FIG. 5 FIG. 6

Marine Engineering

piston next to the large stuffing box is open, and is guided by same. In the sleeve below the piston, holes are drilled which permit the admission of live steam. The area of the piston on which the steam acts must be made equal to the area of the main steam pipe, and so, while permitting perfectly free expansion, it is also perfectly balanced.

The expansion joint at Fig. 3 is more simple than that at Fig. 2, and may be used to great advantage where a right or more acute angle is required in the main steam pipe. The sleeve is simply extended through the main casting, and has a stuffing box on both ends. In the sleeve is cast a deflective diaphragm turning the steam into the side branch. By giving a few figures it will be readily seen how important a function the balanced expansion joint performs, the importance of this function increasing rapidly as the diameter of the piping increases. Take for example a 15-inch steam pipe with 200 pounds working pressure of steam. The area of 15 inches = 176.78; then,

$$176.78 \times 200 = 35.356 \text{ pounds.}$$

or about 15 3-4 long tons unbalanced load on the steam pipe. With the ordinary type of expansion joint shown at Fig. 1, this unbalanced load must necessarily be taken up by the preventer bolts, subjecting these bolts and the castings to which they are attached to this strain. Two other good methods of allowance for expansion are shown at Fig. 5 and Fig. 6, which are simply an S bend and a U bend, respectively. These should be used only in moderate-sized piping, as the larger the diameter of the pipe the more rigid it becomes, this rigidity being enhanced by the necessarily increased thickness of the material. An apparent drawback to this form is that it occupies much more space than an expansion joint, and the claim cannot be made that it is any lighter.

With the perfection to which the *manufacture of steel pipe* has been brought, the ideal steam pipe for high pressures has been realized. Add to this steel flanges welded to the pipe, each pair of flanges being made male and female, and having a wire insertion gasket between them, and we have reached the acme of steam piping at the present stage of steam engineering. It is true that in mercantile work such piping with welded flanges is too expensive and difficult to get to be used in the majority of cases. A good substitute is, where

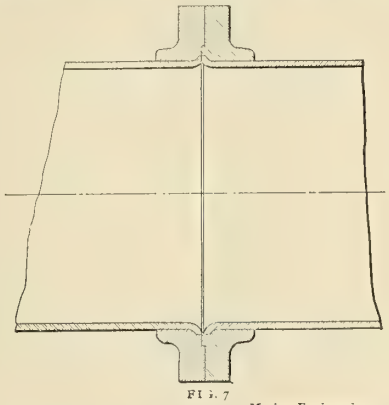


FIG. 7

Marine Engineering

the pipe is expanded into the flange and turned over into a recess, formed in the flange for this purpose, as illustrated at Fig. 7. This method has the very decided advantage of being readily fitted at the place of installment. By kind permission of the Chief of the Bureau of Steam Engineering, I append the principal rules relating to steam pipes issued by that bureau, and which seem particularly well fitted to mercantile requirements as well as to that of the navy.

SPECIFICATIONS FOR COPPER PIPES.

1. The inspection must conform to the "General Instructions for the inspection of material under the cognizance of the Bureau of Steam Engineering."

2. The pipe must be made of Lake copper, and a chemical analysis must show that the metal is 99.5 per cent. pure copper. One analysis will be taken from each lot of 2,000 pounds or less.

3. The pipe must be free from indentations, cracks, flaws, or other surface defects inside and outside, perfectly round, of the specified diameter and thickness in all parts. All straight sections of pipe 6 inches in diameter (inside) or less shall be seamless drawn.

4. Each pipe must withstand an internal hydraulic pressure which will subject the metal to a stress of 6,000 pounds per square inch, the test pressure being calculated by the following formula for thin hollow cylinders, but in no case will a test pressure of over 1,000 pounds per square inch be required.

$$p = \frac{2ts}{d},$$

in which

p = safe internal pressure;
d = inside diameter in inches;
s = safe tensile strength of material = 6,000 pounds per square inch;
t = thickness of pipe in inches.

Every pipe must be perfectly tight under pressure and show no signs of bulging, cracks, flaws, porous places, or other defects.

5. A strip 1 1-2 inches wide will be taken from each lot of 2,000 pounds or less of pipe, and must stand the following tests:

(*a*) If less than half an inch thick, it must stand bending flat back cold after being annealed.

(*b*) If half an inch and over, it must bend back after being annealed until the ends are parallel and the inner radius of the bend is equal to the thickness of the piece.

(*c*) In every case the ends of the bending test pieces shall stand hammering down hot to a knife edge without showing signs of cracks.

6. Pipes of 2 inches inside diameter and over, for steam or feed pipes or other such high pressures, are to be subject to tensile tests, one piece of pipe from each lot of 1,000 pounds or less being selected to represent the lot. If the pipes are from 2 to 6 inches inside diameter, the test pieces are to be cut longitudinally. If over 6 inches inside diameter, they will be cut circumferentially. The test pieces will be heated to a cherry red and straightened when hot, then machined to the shape shown in the sketch, care being taken to have the brazed seam, if any, between the measuring points.

7. For thicknesses up to and including 1-4 inch, the width of the narrow part of the test piece shall be about 1 1-2 inches. For thicker pieces the width shall be such as to give a cross section of about half a square inch, but the breadth shall not in any case be less than the thickness. The rolled surfaces are not to be machined, but to be left in their original condition.

8. The test piece must show an ultimate tensile strength, after being annealed, of at least 28,000 pounds per square inch for all pipe, and an elongation of at least 25 per cent. in 8 inches in the case of seamless pipe.

9. *Thickness.*—Every pipe must be of the specified thickness in the thinnest part. The tolerance for excess of thickness will be allowed as follows:

Pipes up to 15 B. W. G.	12 per cent.
15 to 12 B. W. G.	10 " "
12 to 9 B. W. G.	8 " "
9 to 7 B. W. G.	6 " "
7 to 00 B. W. G.	5 " "

10. *Weight.*—The weight of every pipe must be at least equal to the calculated weight, on a basis of 1 cubic inch of copper pipe weighs .320 pound. An excess of weight equal to 5 per cent. of the calculated weight will be allowed.

SPECIFICATIONS FOR SEAMLESS STEEL AND LAP-WELDED STEEL STEAM PIPES.

1. *Material.*—(*a*) The seamless pipes must be made from solid billets or disks of perfectly homogeneous steel, and cold drawn or hot rolled, as specified in the order.

(*b*) The lap-welded steel pipes must be made of steel of homogeneous quality, and of the grade which is found to insure the soundest welds. The skelp must be rolled true to gauge.

2. *Surface Inspection.*—The pipe must be free inside and outside from all surface defects which would materially weaken it or form starting points for corrosion. The defects to be especially avoided are the same as those mentioned under the head of defects in boiler tubes. The pipe must be perfectly round and vary not more than 1 per cent. above or below the gauge.

3. The following tolerances will be allowed below the specified thickness:

Pipe of all diameters not over 3 inches outside diameter, tolerance .01 inch below.

Pipe 3 inches to not over 5 inches outside diameter, tolerance .02 inch below.

Pipe 5 inches to not over 7 inches outside diameter, tolerance .03 inch below.

Pipe 7 1-2 inches and over, .06 inch below.

4. *Weight.*—The weight will be calculated from the specified dimensions and thickness, assuming that 1 cubic inch of steel weighs 0.283 pound. A tolerance of 3 per cent. under and 7 per cent. over weight will be allowed for all pipe over 4 inches in diameter, and a tolerance of 3 per cent. under and 5 per cent. over weight will be allowed for pipe 4 inches outside diameter or less.

5. *Hydraulic Test.*—Every pipe must be subjected to an internal water pressure of 1,000 pounds per square inch, without showing signs of bulges, cracks, or other defects.

6. *Other Tests.*—Pipe 4 inches outside diameter and less will be tested in lots, and in the same manner as prescribed for steel boiler tubes. Pipes over 4 inches outside diameter may be tested in lots of 10, four pipes being selected from each lot and care taken that the pipes selected for test have had the same treatment as the remainder of the lot, *i.e.*, that they must not be annealed or softened by slow cooling unless the others have been treated in the same way. If the inspector has any doubts that the pipes have all received the same treatment he will test each pipe singly.

(*a*) Two test pieces will be cut circumferentially (when it is practicable to get a strip of the requisite length) from the ends of two different pipes, straightened when hot, and machined to shape and to a width of 1 1-2 inches. For thickness up to and including 5-16 inch, the length between the measuring points will be sixteen times the thickness. For thickness greater than 5-16 inch the length between measuring points will be 8 inches. In the case of welded pipe, the test piece must be cut so as to leave the weld in the middle. The test must show a minimum tensile strength of 48,000 pounds per square inch, and an elongation of at least 12 per cent. in 8 inches or 15 per cent. in 5 inches.

(*b*) Two test pieces of a width equal to three times the thickness of the metal in the pipe cut circumferentially from the ends of the other test pipes, so as to include the weld, if any, shall stand bending cold at the weld to an inner diameter equal to thrice the thickness of the metal, without showing cracks on the outside of the bend.

7. The failure to pass these tests in a satisfactory

manner will reject the lot, unless the manufacturer desires to test each pipe separately, in which case a tensile test shall be taken from one end and a bending test from the other, and the pipe accepted or rejected accordingly.

8. If ends of pipes are flanged, swaged down, swelled, upset, or reinforced, they will be inspected after this work is done, to see that no damage has been done by this process.

9. All cold-drawn pipes must be annealed in retorts or in an improved furnace in which the flame does not strike them.

10. Each pipe will be stenciled with the name of the maker and the number of the government requisition, or name of the vessel for which it is intended, and its location mark when necessary.

NORWEGIAN STEAMER BLAAMANDEN, WRECKED ON THE NOVA SCOTIA COAST.

11. The inspector's identification stamp and the United States anchor stamp will be put on the cases in which the pipes are shipped. If the pipes are shipped in box cars containing no other freight, the cars will be sealed and the anchor stamp put on the seal. In this latter case it will not be necessary to box or crate the pipes.

Wreck of the Blaamanden.

On this page is given a view of another one of the many wrecks to be added to the long list of those occurring on the Nova Scotia coast. It is of the Norwegian steamer *Blaamanden,* which went ashore about 100 miles from Halifax, in a cove, during a thick fog.

The wreck occurred over a year ago. Attempts were made to raise the vessel, but these proved fruitless, and the ship was a total loss. This, it might be added, is the general fate which befalls any vessel striking the rock-bound shores of Nova Scotia, for it is seldom that a vessel is ever released when once she grounds.

ALUMINO-THERMICS,

OR

Production of High Temperatures by Burning Aluminum, and the Application of this to Engineering and Metallurgy.*

BY DR. HANS GOLDSCHMIDT, OF ESSEN-RUHR, GERMANY.

The two elements of most frequent occurrence on our planet are oxygen and aluminum. By producing in a suitable manner the chemical combination of these two, a temperature is created which is about equal to that of the electric arc light. On this discovery is based the new science called alumino-thermics. The proper manner of combining aluminum with oxygen is not by taking the atmospheric oxygen, but the solid oxygen contained in the oxides; these are mixed with finely granulated or pulverized aluminum. The resulting mixture is the heat producer and is called thermit.

The next aim is to produce this great heat in the simplest and most efficacious manner and then to discover the fields on which it can be applied to most advantage.

The first important discovery in observing the properties of this mixture—thermit—was that, when ignited in one spot, the combustion continued throughout the whole mass without any supply of heat from outside. The mass is placed in crucibles which are not in contact with any external source of heat, and the combustion, once started, embraces the whole mass in a very short time. This is the essence of alumino-thermics.

In the crucible after the reaction there are two layers. The bottom one is pure metal of equal weight to, but occupying only one-third of the space of, the top layer, which is now oxide of aluminum, so-called corundum.

*Extracts from lecture delivered at the annual meeting of the American Society of Mechanical Engineers at the Stevens Institute, Hoboken, N. J., December 3, 1903, by the inventor.

These two layers whilst still liquid are poured rapidly over the rim of the crucible. It is not difficult to distinguish between the slag which flows first and the brightly glittering overheated metal.

(To demonstrate the heat created by this chemical reaction, the speaker used thermit to burn a hole through a 1-inch wrought-iron plate.)

You will notice that in this case the crucible is tapped from the bottom so as to allow the pure iron, which has a temperature of about 5,400 degrees F., to run out first. The hole is perfectly smooth edged; the heat is so concentrated that the plate is still cold after the reaction.

Nearly fifty years ago attempts were made to apply the reducing properties of aluminum. Without exception the experimenters heated their compounds externally. The reaction was always so violent that they could only operate with very small quantities. It will easily be seen that to arrive at alumino-thermics on a commercial scale from such a starting point required patient study and assiduous work. Each of the mixtures, although made according to simple chemical rules, required studying out by itself. The formulas for gunpowder or dynamite sound fairly simple, but it requires more than a mere mixture of the ingredients to obtain any effect sufficient for industrial requirements; not as if thermit were an explosive—you can throw it into the kitchen fire and it won't burn.

In all exothermic processes the physical properties of the ingredients, in this case particularly those of the oxides, want considering. Then the methods of manufacture have to be worked out for each case.

In the following I am going to illustrate by practical demonstration a few of the applications of the thermit process; to give an account of the entire field of its utility would go beyond the scope of a single lecture.

The applications may be roughly divided into two main divisions, the one concerning the metallurgist, the other the engineer. The latter application may be summarized in the word "welding." The study of the metallurgical application preceded that of the other.

Amongst the pure metals produced by the aluminogenetic reaction I may mention in the first instance chromium free of carbon as having already found a market in this country. It is used in the manufacture of particular qualities of chromium steel with a limited percentage of carbon. For instance, it is considerably used for self-hardening tool steel with 5 to 6 per cent. chromium, about twice that quantity of tungsten and only .6-.7 carbon. . . .

This first division appertaining to metallurgy I shall abandon for the present in order to acquaint you with the process which has received the widest attention and practical application—the thermit welding process.

Considering the innumerable details connected with the application of so new and practically unknown a force, it is not surprising that only since about a year ago the process has been introduced on a large and commercial scale.

The most important of these welding processes is the one by which a continuous rail—a necessity of modern trolley-road construction—is simply, cheaply, and effectively obtained. Engineers in this country, in which no less than 25,000 miles of single track are in existence, are watching the good results obtained in Europe with this system. European authorities recognize its advantages over all its competitors, about 20,000 joints having been welded by this process since about a year ago in forty cities of the old world. . . .

A marked advantage enjoyed by this system is the absence of any bulky equipment; all that is required is a crucible, a mold box, and, in some instances where a complete butt weld of the head of the rail is desired, a rail clamp. All these materials, including the necessary quantity of thermit, can easily be moved on a hand truck. Each weld, according to section, requires from fifteen to twenty pounds of thermit.

Even where a rail clamp is used the time employed is less than that necessary for fixing fishplates and copper bonds. The mold is made according to a model designed specially for each section. Its two parts, one on each side, firmly enclose and exactly fit the rail. They are made on a large scale by manufacturers of refractory earthenware, or, according to the requirements of the trolley lines, in the repair shops, by tamping an ordinary mixture of china clay and loam into a sheet-iron case placed over the model, which has afterward to be dried during a couple of hours at a temperature of some 212 degrees F. The cost is only a few cents.

The thermit iron running out of the crucible flows round the web and foot of the rail and, melting them, forms one mass with them. The liquid slag which follows the metal is diverted to the top of the rail and brings the latter to welding heat. The whole section is thus heated equally and the rail ends will not buckle. . . .

(Two rails were here welded by thermit.)

Working without clamps the time consumed per joint equals three-quarters of an hour for one man; trained squads of four men, including foreman, did not use nearly so much time. At $1.50 per day the wages item of cost is ten cents per joint. The use of the clamps doubles this amount. All other labor remains the same whether clamps are used or not.

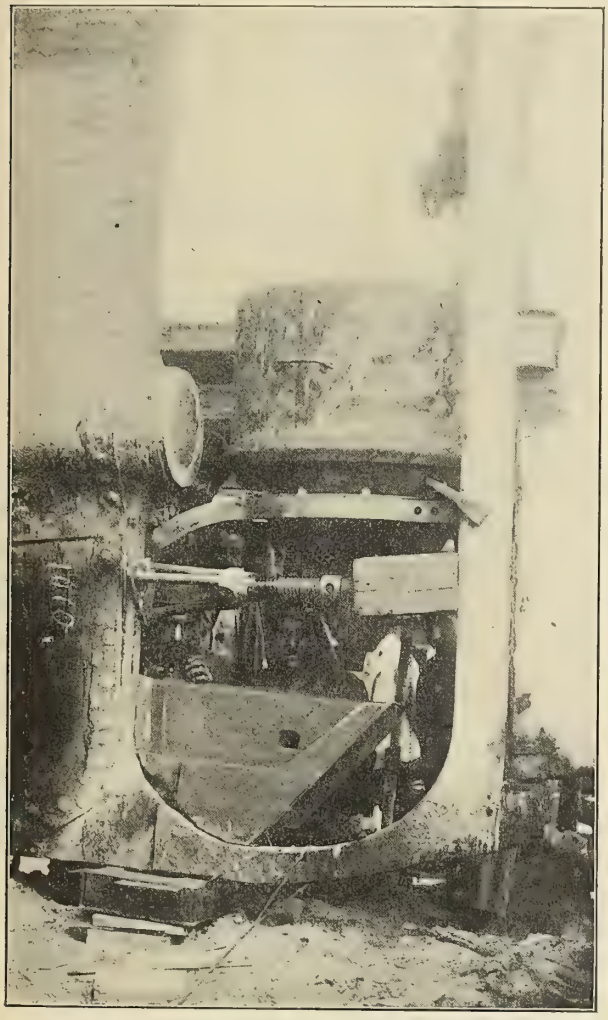
The mold, which must be dry and porous, is screwed on to the rail and the rims touching the rail are carefully smeared with clay. Before doing so, however, the rail ends are cleaned of dirt and rust with a wire brush and slightly warmed; a sand blast is superfluous.

In case the tops of the rails are to be butt-welded the section has to be filed. This is all that is required in the way of preparatory work. A true alignment of the rail is an indispensable precaution. The rails require no bolt holes, as no provisional fishplates are necessary.

You will recognize that none of this work demands special training, and that in this country, as in Europe, the trolley companies' men will be easily able to do it. A certain supervision to see that it is done carefully is a matter of course. The welding is done automatically and does not require the trained eye of an expert welder. In case of wet weather the protection of a few planks is desirable to prevent the mold and thermit getting wet.

The next and only remaining appliance necessary for thermit welding is the crucible. This consists of a sheet-iron mantle lined with magnesia. It is of simple construction, the lining being introduced by tamping it round a cone which is suspended in the middle of the mantle. The bottom is formed by a hard magnesia stone provided with an exchangeable outlet, which will stand nine to ten runs. The crucible, with the cone

in it, is placed in the furnace for only two hours and finally brought to glow heat. It is then ready for use. Crucibles will stand about twenty-five reactions, and the wear and tear will, therefore, amount to only a few cents per joint. The thermit is supplied in small bags



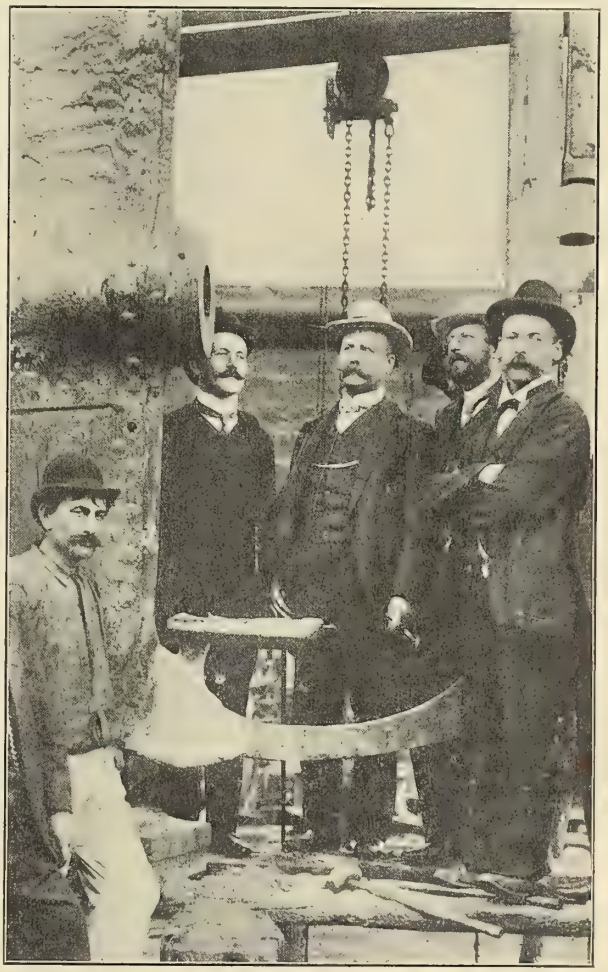
CRUCIBLE AND ONE-HALF THE MOLD IN PLACE.

containing the exact weight which is needed to effect the weld. These are called welding portions, and are sold as such to the trolley companies. The companies who make their own crucibles and molds will, therefore, have to pay freight only on the welding portions, which is considerably less than that on fishplates and bolts. The Essen works have a plant to supply over 500 welding portions daily.

The strength of the weld is about 80 per cent. of the strength of the original material. The shoe welded on to the foot of the rail not only makes up for the remaining 20 per cent. but materially strengthens the rail at the joint. The head does not get softer, although it is brought to welding heat; the reason being that the operation takes place without the air having access to it. Test rods cut out of rails brought to welding heat with thermit prove that tensile strength and elasticity have not suffered; a fact which is confirmed by three years' practical experience on the road.

Steel girders for construction work can of course be welded in just the same way as rails. For really solid jointing equal to the strength of the girder itself welding is cheaper than riveting. There will be a wide field for this work in the United States as soon as the preparatory experiments and calculations have been made and officially sanctioned. After the experiments you have seen here you will acknowledge the immense saving of time in using the welding process as compared to riveting.

The next field of application I shall now touch upon is an exceedingly wide one—the repair of solid iron and steel objects. Thermit, as I told you, gives 50 per cent. of mild, very overheated steel with .1 carbon, which can be hardened if desired, for instance by an addition of manganese. *Whoever has a supply of thermit has a supply of liquid steel.* Accordingly foundries can correct faulty castings, machinery shops can mend broken or worn-out parts, and last, but not least, marine en-



AFTER WELDING THE STERN FRAME.

gineering works can repair large steel castings, such as crank shafts, and particularly broken stern posts.

Wherever the distance from construction shops is a matter of consideration, and in all outlying districts, this thermit is of particular value. Within the last few months regular ton orders have been received from

South Africa, where damaged machinery of all kinds has been repaired by it in the mining districts. In many cases cast iron has been welded.

Certain rules have to be observed in all repair work. First and foremost the slag should not be allowed to get mixed up in the plastic iron. An appropriate position of the runner and a little experience in the construction of the most effective shape of mold will prevent this. The mold must be made so as to allow the liquid iron which runs out of the crucible to flow freely round the flaw or fracture and to rise in the rising pipe. The latter must be large enough to hold sufficient metal, that the walls of the flaw, etc., are fused. The weld can be either effected by running the thermit iron round the ends of the piece in the shape of a ring, or by both running it between and around at the same time. The size of molds and quantity of thermit necessary for welding shafts up to 300 mm. diameter have been tabulated. A 12-inch diameter takes 190 pounds of thermit, giving 95 pounds of mild steel.

The most startling and at the same time most effective work done in the way of repairs by thermit is in connection with marine engineering. To weld broken stern posts of big transatlantic liners, or crank shafts or similar pieces, crucibles six feet in height with a capacity of seven hundredweight have been constructed. The reaction in these takes hardly longer than in a small crucible. The enormous advantage offered to steamship owners by such repairs will be apparent when it is remembered that a broken stern post would otherwise have to be replaced by a new one. Besides this expense the one incurred through loss of time, the steamer being laid up in dry-dock for weeks and weeks in order to have the new part fitted in, is very heavy indeed.

I now come to an application of thermit which differs materially from the ones I had the privilege of demonstrating to you up to now. That is welding wrought-iron pipes.

Of course, the heat of the iron if applied direct would destroy the thin walls of the pipe. Here, then, the corundum slag created on the top of the mass in the crucible comes into play. On being poured it has the properties of adhering instantaneously in a thin layer to any object that it comes in contact with, and of being impervious to liquid thermit iron. The sequence of operation is therefore changed, and the slag is made to flow out before the iron. The reaction takes place in a crucible with a solid bottom, from which the contents are poured over the rim.

To butt-weld the pipes the ends must be made to fit accurately on to each other and must be made bright with a file or emery paper. The two pipes are then firmly pressed together by the clamping apparatus, and the sheet-iron mold, well surrounded with moist sand, is attached. After pouring the liquid contents of the crucible, welding temperature will take place within a minute or two. The clamps then want tightening one turn of the screw and the weld is complete. The mold box is removed almost at once and can be used several times. The surrounding mass, containing the iron between the layers of slag, like the yolk in the white of an egg, is easily removed with a hammer. Such welds will stand pressure of hundreds of atmospheres; as a matter of fact as much as the pipe itself. About 30,000 to 40,000 pipe joints have been welded by this method, the advantages of which are, shortly, that the operation can take place anywhere, and that it is cheaper than a solid flange joint. The dimensions of the molds have been carefully worked out and tabulated for every size of wrought-iron pipe up to six inches diameter. Any workman will be able to make such welds after very short practice by carefully observing the few rules and directions printed in the pamphlets.

One of my associates, Mr. Mathesius, has specially devoted himself to studies concerning the improvement of iron and steel castings. These are obtained by introducing the thermit below the surface of the bath, and so producing a high temperature in one place. A box containing the thermit is fastened to an iron rod and held down on the bottom of the ladle.

For cast iron, and, in some cases, for steel, a special thermit is used which gives off an alloy of iron with titanium so that the titanium enters the liquid metal. The reaction takes place all through the contents of the ladle and thoroughly stirs them up in the space of a minute or two. Gases and particles of slag are driven upward so that the fluidity of the iron is increased. An increase of the temperature does not in reality take place, as the proportion of added thermit is only one-quarter to one-sixteenth per cent. of the total contents of the ladle. The effect of the titanium is to bind small quantities of nitrogen, to increase the fluidity of the cast iron, and to produce a finer grain.

Another application of the so-called "box reaction" is important for steel castings, and especially for casting large steel ingots, to prevent the familiar phenomenon of piping. In the heads of such blocks hollow spaces are found which mostly cause 30 to 40 per cent. of loss.

The thermit process as used for this purpose consists in introducing a box of so-called anti-piping thermit into a block with the aid of an iron rod, in exactly the same way as described before. According to the size of the block the box is suspended about three feet. The reaction is completed in this case in a few seconds. The box is introduced, of course, only after the piping has been formed. The head layer, which has already become solid, is broken through for this purpose. Immediately after the reaction is completed, steel, which is held in readiness for this purpose, is poured into the open hole. The method is really very simple, and one learns very quickly at which time to introduce the box. Moreover it is very cheap, only about ten pounds of thermit being required for blocks of ten to twenty tons weight. After the treatment relatively very small flaws were found, and only in the upper part of the block, so that the loss is only a very few per cent.

The method has also been applied for very large steel castings to revive steel which had become plastic in the runners. In this the anti-piping thermit is placed at the bottom of some risers, in an annular box with concentric walls, containing about two and one-half pounds of thermit.

The difficult operation of casting long stern posts of vessels can be facilitated by inserting in several places boxes of this thermit. On account of the long way steel has to travel it has a tendency to grow plastic. But coming into contact with thermit its temperature and thereby its fluidity is revived.

Italian-Built Cruiser.

The protected cruiser *Rivadavia,* built at Messrs. Ansaldo and Company's yard, Genoa, Italy, holds the record for speed in construction. The ship was contracted for by the Argentine Republic and the keel was laid March 10, 1902. On October 22 of the same year the vessel was launched, and on May 14, 1903, the dock trial was successfully run. Thus, fourteen months from the date of laying the keel the vessel was practically completed. The accompanying view was taken on May 12. In the same yard is being pushed the work on her sister ship, *Moreno,* shown at the middle of the engraving at the top of this page, and which was described and illustrated in the April, 1903, number of MARINE ENGINEERING. At the left of the engraving is the *Messhoudjeh,* at the right the *Rivadavia.*

SHIPYARD OF MESSRS. ANSALDO AND COMPANY, GENOA, ITALY.

PROTECTED CRUISER RIVADAVIA, BUILT FOR THE ARGENTINE REPUBLIC; VESSEL COMPLETED IN FOURTEEN MONTHS FROM DATE OF LAYING KEEL.

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WHILE the year closing has been a dull and in some cases a disastrous one to the shipbuilder, it has recorded many important steps in the advancement of marine engineering in both the general departments of hull and machinery. In the first place, the value of the experimental tank has been further demonstrated in this country by the results obtained at Washington with models of the new battleships, whereby an increased speed may be obtained at less horse power on the same displacement than in the ships built before this tank was in use. Doubtless the experimental tanks abroad have been the means of gathering valuable data, but the policy of the owners has been to keep such information private, which is quite the reverse of the practice at our Washington tank.

Again, in the closing days of the year, there was launched another leviathan, the greatest ship afloat, which is to fly the house flag of the White Star Line and has been named the *Baltic*, of 725 feet in length and about 40,000 tons displacement. As the succeeding years witness the construction of ships larger than ever before built, it is impossible to foretell what the limiting dimensions will be for size and speed. The above-mentioned ship is to be of but 16 1-2 knots speed; but the year also records a contract between the Cunard Line and the British government, by which that steamship company is to build and operate, under the English flag and patronage, two ships larger and faster than any vessels yet afloat. The dimensions of these vessels have not yet been finally decided upon, but it is understood that they will reach a length of 800 feet and be of greater displacement than the *Baltic*. Concerning the enormous power for driving these ships we will speak later on. Four large ocean steamers were launched this year from our Atlantic shipyards and but one now remains on the stocks. The Coast yards have had a light year, while the yards on the Great Lakes turned out a large tonnage.

Another important event in the year has been the signing of the contract of two 540-foot transatlantic liners for the Allan Line to be fitted with steam turbines. In Great Britain the turbine has met with success especially in its application to marine service; but as yet all boats so fitted have been either of the torpedo-boat or the coast and cross-Channel types. The report of the joint commission appointed by the British government and the Cunard Line to investigate the steam turbine with a view of fitting it on board the new Cunard liners is looked forward to with great anticipation, as the commission, composed of prominent engineers, is to carry on elaborate and comprehensive tests. One of the plans consists in testing two very similar new Channel steamers, one fitted with turbine engines and the other with reciprocating engines, for the purpose of comparing the coal burned, water evaporated, economy of operating, etc. Should this commission report in favor of the turbine, a most decisive step will be taken, as it is understood the power to drive these ships at the speed of 25 knots will be in the neighborhood of 60,000 or 70,000 indicated horse power. In this country reports have been made to the Bureau of Steam Engineering by boards delegated to witness the trials and investigate the machinerry of two types of turbines. These boards recommend that turbines be installed on some government ship for the purpose of further tests.

The long and hard-fought battle between the water-tube and Scotch boiler has had another severe conflict this year; and, taken as a whole,

the water-tube boiler has risen to a stronger position than ever before. The report of the Boiler Committee of the Admiralty has practically reversed the previous findings of this body, which were adverse to the water-tube, more especially the Belleville type. Through the wisdom of our navy in installing in our warships recently completed or completing water-tube boilers of several makes, the selection of the best types will eventually be ascertained. The American yachts are almost exclusively fitted with water-tube boilers; but, with one notable exception, on all merchant salt-water ships launched this year, except the smallest craft, Scotch boilers were installed. The ship owner is yet waiting for the navy to decide this vital question before he will leave the trusty Scotch boiler.

The restriction of the output of the oil fields, or rather the increased quantity required for the arts, has raised the price of fuel oil to a figure almost prohibitive for marine consumption, except in certain localities, notably among which is the Pacific coast. The very elaborate tests of oil as fuel conducted by the Bureau of Steam Engineering have been completed and the records are soon to be published. These tests are the most complete ones of the kind ever made and will form a valuable addition to the information on this subject.

Turning now to the auxiliary equipment, we find that engineers generally are paying more attention to this long-neglected subject. Breakdowns at sea of these numerous machines have been of frequent occurrence. The necessity of good design and workmanship is, we believe, better realized to-day than ever before; it is not only necessary to have a good machine, but to so place it in the engine room that the engineer or machinist may conveniently get at it. One thing has been definitely decided this year and brought to general attention, and that is the absolute necessity of keeping oil and salt out of water-tube boilers. This means that the distillers, evaporators, and separators should be properly designed and run, and that the condenser must be kept tight. While these simple statements have always been generally conceded, the full truth has not been realized. In Great Britain superheaters have been installed to some extent on board ship with marked advantage, but they have not been used in this country.

If during the coming year no startling innovation is made in marine engineering, the closing of 1904 would record most marked economies in marine engineering if the attention of engineers were directed to details.

PRESIDENT ROOSEVELT'S message to Congress contained much space devoted to the consideration of the American merchant marine, and he recommended that a commission be appointed, to consist of the Secretary of the Navy, the Postmaster-General, the Secretary of Commerce and Labor, and three members each of the House and Senate, which would investigate the general subject of our shipping and report at the opening of the next session of Congress what legislation, if any, should be enacted for the protection of our ships. While it is gratifying to shipping interests to see the attention which the Chief Executive has given to this subject, it is to be regretted that he recommends the final action be delayed. The public generally has become very well posted, particularly in the last few months, on this subject, and it is to be assumed that our legislators have kept apace with public opinion, in which case it is high time that immediate action be taken. A general realization of present conditions has been slow, yet the acquiescence of all interested to practically one form of remedy has, we believe, been obtained. Also, the crying need for protection has become still more distressing; and, while conditions have been going from bad to worse, it is the general opinion that the next step will be ruin to the shipbuilders.

The movement has some splendid champions and leaders in and out of Congress. Senator Frye's reply to a reported conversation with the director of one of the largest transatlantic lines, in which the director decries any movement on the part of the United States to protect American shipping, shows how extremely well posted the Senator is with the history of our own and foreign maritime subsidies. It has often been stated that bills brought before Congress for the protection of American ships were defeated through the influence of the great transatlantic, foreign-owned lines. This result is naturally to be expected, but such interference only strengthens the armor of the protectionist, as it shows how foreign companies are profiting through our unprotected shipping. We urgently recommend to Congress that the investigation of the present condition of marine affairs be immediate.

A Bad Crank Pin.

Editor MARINE ENGINEERING:

Several articles that have lately come to my attention through your valuable paper, in connection with repairs to marine engines, remind me of a job that I saw, while visiting a large shipyard in the far East, that was a little out of the ordinary both as regards the means employed to locate a weak spot in an engine, and the business methods of the company which made the repairs.

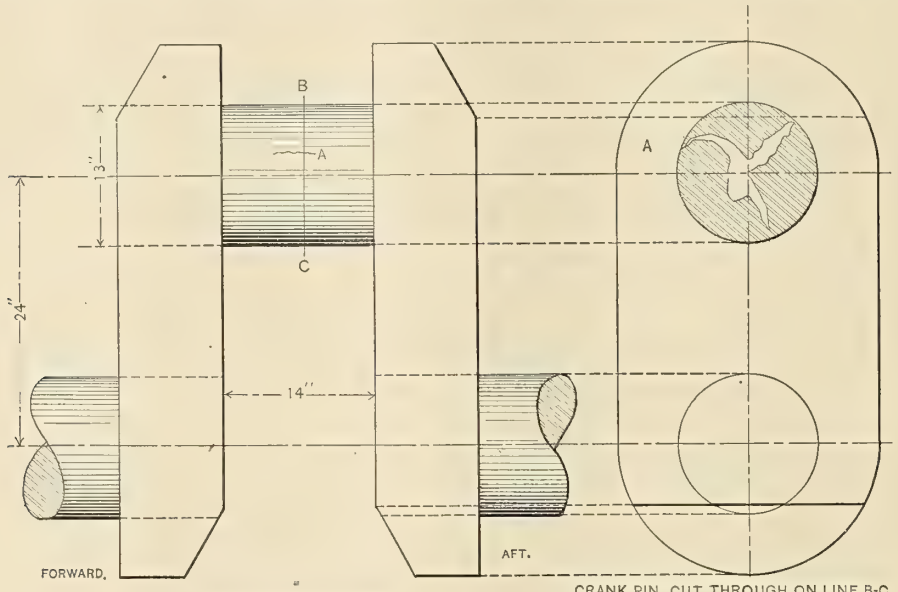
The job in question came from a large, single-screw ocean freighter, and was the intermediate section of crank shaft of a large triple-expansion three-cylinder engine. I should say the engine was about 30, 46, and 72 inches by 48 inches stroke, the crank shaft being built up and in three sections, with a coupling between the high-pressure and intermediate-pressure, and another between intermediate-pressure and low-pressure engines. The engine had run as well as usual, and the outward voyage had been an uneventful one until a strong northeast monsoon was struck, the ship being then well up the China sea.

As the sea became unusually heavy the engines were eased to three-quarter speed, when, shortly after slowing down, the crank pin of the intermediate engine was found to be unduly heated, and it also became apparent that the temperature of the pin was fast rising. The speed was then still further reduced to one-half, and extra oil and water were administered to the heated pin in heroic doses. This reduced the temperature to a considerable extent, and it was deemed advisable to try and make the few remaining knots to port at a reduced speed rather than risk taking anything adrift in the heavy sea then running.

On mooring the ship, after reaching port, the brasses were opened out for examination, when it was found that they showed slight cutting of the upper and lower halves for a length of about 2 or 2 1-2 inches all the way around and nearly in the center of their length. This would, of course, indicate that the trouble was to be found with the pin.

On jacking the engine around, the pin was found to be in perfect condition, except for a very fine, hair-like, wavy line, as shown in the sketch about in the position marked *A*. By rubbing the hand carefully at right angles to this line it could be readily noticed that one edge of the apparent crack was higher than the other and had been acting as a scraper in the brasses, thus causing the heating. It appeared to be a "cold shut," or lamination in the steel, and on a very close inspection there seemed to be a very minute portion of the metal missing along the edge.

Mr. M., the superintending engineer of the works, was called aboard and asked his opinion as to what he thought was wrong with the pin. After he had made a very careful examination of both pin and brasses and asked several questions relating to the weather encountered on the voyage, and when it was noticed that the pin was beginning to heat, he gave as his opinion, without the least hesitation, that the pin was hollow in the center—a bad forging—and was therefore unsafe and would require to be replaced with a new one. This at once called forth some very warm arguments between himself on the one side and the captain and the chief engineer of the ship on the other side. The captain and the chief then asked Mr. M. why he was so positive that the pin was a bad forging.



CRANK ON TOP CENTER

CRANK PIN ,CUT THROUGH ON LINE B-C. SHOWING HOLLOW PORTION

Marine Engineering

"Well," said he, "you had no trouble with the pin during nearly 15,000 miles of steaming, and the pin did not give any trouble until the engine began to race after you got into bad weather; then you found it beginning to heat all of a sudden."

"Yes, yes, we will admit all that," said the chief.

"Well, then," remarked Mr. M., "when that pin started to heat, then it started to let go. And, furthermore, I will show you that it is 'gone,' if you will let me, and I will now make you the following proposition: I will drill out the old pin and shrink in a new one;

then I will put the old pin in a lathe, cut it in halves through the crack, and when you see the two halves of that pin, and it then proves to be a bad one, then you are to pay us for time and material on the whole job. On the other hand, if the pin proves to be of good material, and perfectly sound, then I will make your owners a present of the whole job, complete and ready for sea."

At first the chief demurred, and thought the pin and brasses could be "dressed up" and made a good job. But Mr. M. was immovable, and promptly told the captain and the chief that, inasmuch as he had spent twenty-six years in building up a reputation for his firm and himself, he did not propose to jeopardize it for one crank pin. It was then decided to remove the old pin and put in a new one, and, the shaft being in three sections, the intermediate was taken adrift at once.

I had become greatly interested in the job, and through the courtesy of the superintendent followed it along as the work progressed, and made a few sketches for my own benefit. I was at the works when the halves of the old pin came out of the lathe, and I now reproduce, in the present sketch, the condition of it, as nearly as I can from memory and measures taken at the time.

The pin, after being put in the lathe, was cut through the flaw marked *A*, on the line *BC*, and referring to the cross section, it will be readily seen the pin was certainly in bad shape. I took a sheet of stiff white paper, and with the aid of a light hard-wood mallet I obtained a very good impression of the flaw, as shown in the cross section of the pin. This flaw, or, more properly speaking, the area of it, I obtained with a planimeter.

The area enclosed by the bad portion I found to be 15.89 square inches, or a reduction of the true area of the pin of about 12 per cent. The edges of the flaw, after careful inspection, were found to be 1-8 inch from the finished portion or surface of the pin, except at the point *A*. How much longer this pin would have continued to hold on can of course only be guessed at, and what would have happened had there been a dissembling of parts through its letting go altogether is of course another guess, but I think it would have been just as well to stand from under. The shop in question had at the time nearly five years' work ahead, nearly all of which was new and hurried, and, under these circumstances, could not, of course, have been begging for work. Mr. M. should have been heartily thanked for saving the owners of this ship a probable chance of having the vessel drifting about helpless for a week or two in the China sea or the Indian ocean, and finally furnishing a nice fat salvage job for some lucky but often despised ocean tramp steamer.

Chefoo, China. E. A. BLACKWELL, U. S. N.

German Launch.

Editor MARINE ENGINEERING:

The description of the German launch *Moguntia*, given in your number for November, just to hand, is an interesting illustration of how ideas tend to repeat themselves.

In the year 1874 or 1875, or it may be 1876 (I have not the papers at hand just now and cannot verify the date), a paper was read before the British Institution of Naval Architects by a gentleman from Manila advocating exactly the same basis of design as is called for in the case of the German launch of the tetrahedral form. The writer of the paper spoke of having built at least one yacht on the principle, and I remember being very much taken with the idea. In the course of conversation afterward I found that the idea was even then far from new, the Cornish luggers of that time being built upon a modification of the same principle. It was pointed out that the geometrical base of the form consisted of making the cross sections of the vessel of triangles, lessening in depth and increasing in width from forward aft, so that the load-water plane formed a triangle. It was also pointed out that, as modified to suit exigencies in a sailing craft, this led to what was called a raking midship section; that is, a line drawn on the sheer plan from the base upward, so as to pass through the point of greatest breadth on each horizontal plane, would be inclined aft.

Altogether I built several small sailing yachts as near this principle as I dared to go, but the results were disappointing; in the first one the greatest depth was carried too far forward and the greatest breadth too far aft, and the boat was very bad to handle in any little jump of a sea, while in smooth water with a fresh breeze, as she heeled, she put her head down and ran off her helm. In light winds the excessive skin friction was too much for her. Successive experimental boats left the impression that a midship section raked at about 45 degrees was as much as one could venture, and it was always a question whether the result was worth the trouble.

These conclusions of course refer only to sailing craft, and I should think that there would be more useful scope for this principle in steam craft intended for speeds well above the normal wave-making point.

WILLIAM CAMPBELL WILSON.

Thetford, Norfolk, England.

PERSONALS.

Robert G. Griswold, who formerly held the position of inspector of machinery, U. S. N., at the works of the Harlan and Hollingsworth Company, has been transferred to a government position at the yard of the Fore River Ship and Engine Company.

Walter H. Whiteside, manager of the retail and supply department of the Westinghouse Electric and Manufacturing Company, has also been made the general manager of the Sawyer-Man Electric Company, and has added the duties of this new office to his former ones. He has been connected with electrical trade interests for nearly twenty years and with the present company for many years.

H. F. J. Porter, who has been associated with Westinghouse interests since the first of the year, and has held the position of assistant manager of the publishing department, with offices in East Pittsburg and 10 Bridge street, New York, has been made second vice-president of the Nernst Lamp Company, of which enterprise Mr. George Westinghouse is president, with the duties of general manager and headquarters at Pittsburg. He assumed charge on December 1.

THE DESIGN OF MARINE MACHINERY.

BY W. F. DURAND.

[11] The Stephenson Link.

The types of valve gear with which we have been thus far concerned are only adapted for continuous rotation in one direction. Our main purpose has been, in effect, the study of the movement of a valve actuated by a single eccentric, simply as a first step toward the study of more complex forms of gear suitable to motion in either direction and with varying degrees of expansion ratio. As the first of such type of gear we shall take the Stephenson link. As shown in skeleton in Fig. 20, this gear has two eccentrics, P and Q, located at equal angular distances, KP and KQ, from the crank C. Each eccentric gives motion, through an eccentric rod, to one end of a curved bar or link, AB: P to the end A, and Q to the end B. From some intermediate point on this link, as H, motion for the valve is taken.

The first step in the study of this gear consists, therefore, in an examination of the motion of the point H, or at least of the component of the motion which is effective along the

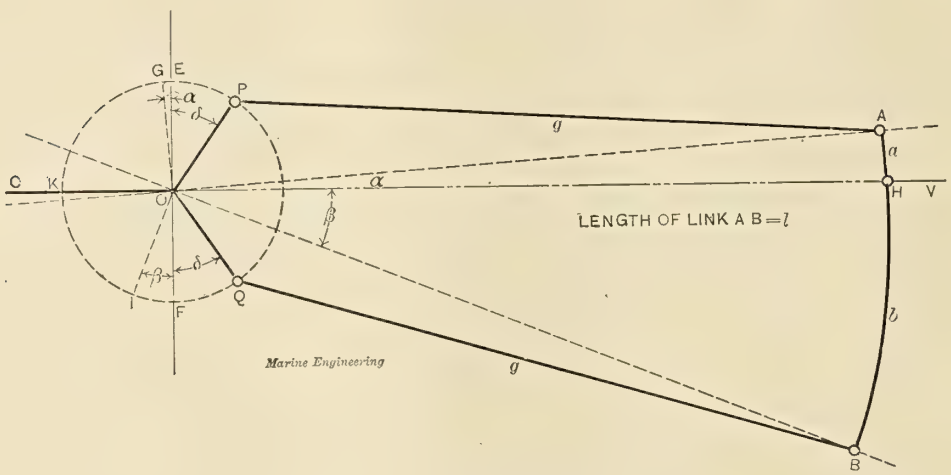


FIG. 20.

line of movement of the valve rod, OHV. The exact investigation of this problem would prove very complex and tedious, and it is found advisable, therefore, to accept an approximate treatment, which is very much simpler, and which gives the motion with all the accuracy required for most practical purposes.

In this mode of treatment we first consider the component of the motion of A along the line OA, and that of B along the line OB. That is, we consider P and Q as simple eccentrics, the first giving a certain motion along the line OA, and the second along OB. Denote the angles HOA and HOB by α and β, as shown. Then the angular advance of P relative to the component motion along OA is to be reckoned from a line OG perpendicular to OA, or at an angle α to the left of OE. Similarly the angular advance of Q is to be reckoned from a line OI perpendicular to OB and at an angle β to the left of OF. The angular advance of P for the component motion along OA is therefore POG or $(\delta + \alpha)$, and that of Q for the component motion along OB is QOI or $(\delta + \beta)$.

Referring to the equation for the movement given by a simple eccentric, [4] (2), it follows that the component motion along OA due to P is:

$$y_1 = r \sin (\theta + \delta + \alpha) \quad \ldots\ldots (1)$$

while the component motion along OB due to Q is:

$$y_2 = r \sin (\theta + \delta + \beta) \quad \ldots\ldots (2)$$

This latter equation, however, would be for motion of the crank in the direction from K to Q. If we suppose the crank to be moving in the direction from K toward P, then for Q we must consider θ as negative, and we shall have for the component due to Q:

$$y_2 = r \sin (-\theta + \delta + \beta) \quad \ldots\ldots (3)$$

Now, denoting by a and b the parts into which the link AB is divided, it will be clear that

the resultant motion of H will partake partly of that due to A and partly of that due to B, and that the fractional part due to each will vary inversely as the distance of H from the two ends. That is, the fraction $a \div (a + b)$ will come from B, and the fraction $b \div (a + b)$ will come from A. Again, while the motion of A due to P, as given by the equation above, is, strictly speaking, to be estimated along OA, yet, since in practice the angle α is small, the error in taking this as the equivalent of the motion along, or in the direction of OH will be very small and may be accepted for the sake of the simplification which it will bring. Similarly for the motion of B along OB, and we therefore have for the two fractions of the motion of H along OH the relative values given above. Hence, calling y the total motion, we have:

$$y = \frac{b}{l} r \sin(\theta + \delta + \alpha) + \frac{a}{l} r \sin(-\theta + \delta + \beta) \quad \ldots\ldots (4)$$

If we expand the values of $\sin(\theta + \delta + \alpha)$ and $\sin(\delta + \beta - \theta)$, we shall have the following expressions:

$$\text{Sin } \delta \cos \alpha \cos \theta + \cos \delta \sin \alpha \cos \theta + \cos \delta \cos \alpha \sin \theta - \sin \delta \sin \alpha \sin \theta$$
$$\text{Sin } \delta \cos \beta \cos \theta + \cos \delta \sin \beta \cos \theta - \cos \delta \cos \beta \sin \theta + \sin \delta \sin \beta \sin \theta$$

Since α and β are very small angles, we may, without serious error, substitute 1 for both $\cos \alpha$ and $\cos \beta$, and also $a \div OA$ or $a \div g$ for $\sin \alpha$, and similarly $b \div g$ for $\sin \beta$. Making these substitutions, we find for the two expressions:

$$\frac{br}{l}\left(\sin \delta \cos \theta + \frac{a}{g} \cos \delta \cos \theta + \cos \delta \sin \theta - \frac{a}{g} \sin \delta \sin \theta\right)$$
$$\frac{ar}{l}\left(\sin \delta \cos \theta + \frac{b}{g} \cos \delta \cos \theta - \cos \delta \sin \theta + \frac{b}{g} \sin \delta \sin \theta\right)$$

Adding these we have:

$$y = \left(\frac{(b - a)}{l} r \cos \delta\right) \sin \theta + \left(r \sin \delta + \frac{2abr}{gl} \cos \delta\right) \cos \theta \quad \ldots\ldots (5)$$

Now denoting the coefficient of $\sin \theta$ by P and that of $\cos \theta$ by Q, we have:

$$y = P \sin \theta + Q \cos \theta \quad \ldots\ldots (6)$$

It will be noted that the coefficients P and Q depend solely on the dimensions and proportions of the gear, and are independent of the angle θ. Comparing these with [4] (3), it will be seen that it is in the same general form as that derived for the movement of a simple eccentric. This is a most important fact and its significance should be carefully noted by the student. It means that for any adjustment of a Stephenson link there is some single eccentric which would produce substantially the same motion. The throw and angular advance of this equivalent single eccentric would not, of course, be that of the eccentrics P and Q of the gear. We must therefore determine what this throw and angular advance are, and how they are related to the various dimensions and adjustments of the actual gear. Referring again to equations [4] (5) (6), it is seen, where P and Q are the coefficients of $\sin \theta$ and $\cos \theta$ respectively in the expression for the valve movement, that the throw and angular advance of the eccentric are determined as follows:

$$r = \sqrt{P^2 + Q^2}$$
$$\tan \delta = \frac{Q}{P}$$

If, therefore, we denote by r_0 and δ_0 the throw and angular advance of the equivalent or virtual eccentric for the Stephenson link, we shall have similarly:

$$r_0 = \sqrt{P^2 + Q^2}$$
$$\tan \delta_0 = \frac{Q}{P}$$

where P and Q denote in equation (6) the coefficients of $\sin \theta$ and $\cos \theta$ respectively.

It appears further, as a graphical construction, that we could construct r_0 by laying off P and Q as the two sides of a right-angled triangle, as illustrated in Fig. 21.

Now, taking the expressions for P and Q as follows:

$$P = \frac{(b-a)}{l} r \cos \delta$$
$$Q = \left(r \sin \delta + \frac{2abr}{gl} \cos \delta\right)$$

it is seen that, outside of the fixed dimensions of the gear, the only quantities involved are the parts a and b of the link AB, and that the variation in these means simply a change in the location of the link block H between the ends A and B.

If now we suppose that the link block H is made to occupy all possible locations between A and B, and that the corresponding values of P and Q are found and laid off as the two sides of a right-angled triangle, starting from a fixed point, as O in Fig. 21, then it is clear that the outer ends of this hypothenuse, representing by its length and angular position the length r_0 and angular advance δ_0, will lie on a curve somewhat as indicated in Fig. 22. This curve will be in effect the locus of the outer end of the virtual eccentric throw, and lines drawn from O to this curve will represent in angular advance and throw all possible values of r_0 and δ_0 corresponding to varying adjustments of the gear as regards the position of the link block.

It may be further noted that of these values P and Q, the former will decrease and the latter will increase as the block is brought from the end toward the center of the link, thus giving a curve of the general character shown in Fig. 22.

We may next note that where the block is at the end of the link, $a = 0$ and $b = l$. Hence we have $P = r \cos \delta$ and $Q = r \sin \delta$. This shows, as we should expect, that in this condition the virtual eccentric becomes the real eccentric. Again, when the block is in the middle of the link, $b = a = l \div 2$, and we have

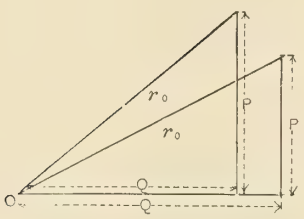


FIG. 21.

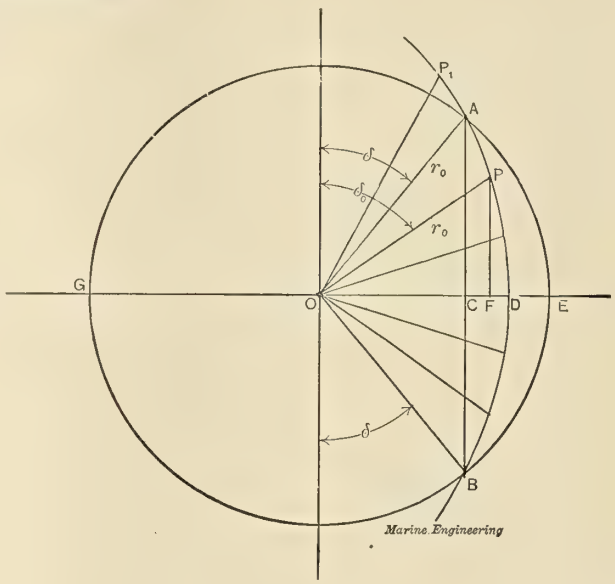


FIG. 22.

$$P = 0 \text{ and } Q = \left(r \sin \delta + \frac{2a^2}{gl} r \cos \delta\right) = \left(r \sin \delta + \frac{l}{2g} r \cos \delta\right)$$

Referring to Fig. 22, it is seen that $OC = r \sin \delta$, and hence the distance CD will be measured by $\frac{l}{2g} r \cos \delta$, thus making up for OD the total value of Q as expressed above.

Now, it is found by experience that if the point D is thus located and a circular arc is then struck through A, D, and B, the curve ADB thus resulting is a very close approximation to the actual curve determined in detail, as explained above.

It will be of interest, however, to ascertain the character of the curve ADB, and this may be easily done as follows:

Counting from O as origin, denote the value of P by y and that of Q by x. Then we have as the co-ordinates of the curve:

$$y = \left(\frac{b - a}{l}\right) r \cos \delta$$

$$x = r \sin \delta + \frac{2abr}{gl} \cos \delta$$

Now, suppose that $a = el$, where e is a certain percentage or ratio. Then $(b - a) \div l = (1 - 2e)$ and $ab \div l = e\ (1 - e)\ l$.

Substituting we have:

$$y = (1 - 2e)\, r \cos \delta$$

$$x = r \sin \delta + \frac{2e\ (1 - e)\ l}{g} r \cos \delta$$

Now, to find the equation to the curve in terms of x and y as co-ordinates, we have only to eliminate e between these two equations. By ordinary algebraic processes this leads to the following equation:

$$x = -\frac{l}{2gr\cos\delta}y^2 + \left(r\sin\delta + \frac{l}{2g}r\cos\delta\right)$$

It may be readily seen by the usual tests of analytical geometry that this is the equation to a parabola with general form as shown in Fig. 22 and passing through the three points A, D, B determined as described above.

The use of the circular arc passing through these same three points is then justified by the fact that the actual test shows the circle to lie very close to the parabola and to practically replace it for all ordinary uses. A like test further shows that for all practical purposes the curve ADB may be considered as a miniature of the link, and that the virtual eccentric for various positions of the block in the actual link may be determined with all necessary accuracy by locating a point such as P, Fig. 22, at a corresponding point on the curve, and drawing the line OP to such point. This is equivalent to assuming that any point P on the curve ADB will represent with sufficient accuracy the location of the block in the link itself, and that as the actual link is hooked up to various positions the operation may be represented and the virtual eccentric determined by supposing a point P to move similarly on the curve, and by drawing a series of radii to such points.

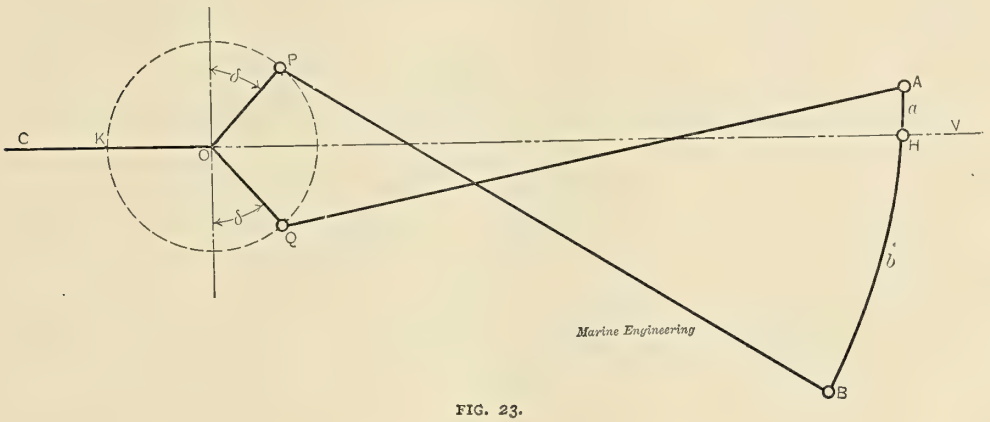


FIG. 23.

In some cases the link overruns at the end, and the block passes outside the point of attachment to the eccentric rod. This is represented by a point P_1 on the curve extended beyond A and B as shown. Actual test here also shows that such an adjustment of the link may be thus represented, and that the virtual eccentric may be represented by drawing a line as OP_1 to the point in question.

The arrangement of Fig. 20 shows the eccentric rods open when the crank C is turned away from the cylinder. In Fig. 23 is shown in similar outline the arrangement with rods crossed when the crank is turned from the cylinder. The former arrangement is known as the "open-rod" and the latter as the "crossed-rod." An investigation of the resulting movement would show that it was similar with certain changes of algebraic sign, and as a consequence of which the curve of virtual eccentrics is turned the other way, as shown in Fig. 24.

To find the locus of the other ends of the virtual eccentric throws for any arrangement of Stephenson link, we have therefore the following simple steps:

(1) Lay off the actual eccentrics, as at A and B, Fig. 22 or 24, and draw the lines OE and AB.

(2) Find the fraction $l \div 2g$ of the distance AC and lay it off as the distance CD, thus fixing D to the right or left, as the gear is open-rod or crossed-rod.

(3) Find by trial the center of a circular arc which will pass through ADB, and describe such arc, which will be the locus desired.

This will serve to determine the characteristics of the virtual eccentric for any adjustment of the gear, and hence, by the application of some one of the preceding simple constructions, all questions regarding the characteristics of the valve movement may be determined.

By reference to Fig. 22 and to the construction for the Zeuner diagram, it will be clear that with the open-rod form, as the gear is linked up, the virtual angular advance increases,

the virtual throw, valve travel, and port opening decrease, the lead increases, and the cut-off becomes earlier.

For the crossed-rod form the changes are of the same general character, except in the lead, which decreases as the gear is linked up.

The chief point of difference in the two forms of gear is seen to be in the lead, which increases with open-rods and decreases with crossed-rods as the gear is linked up. While both forms of gear are met with, the open-rod type is the more frequently employed. This is due to the fact that as the cut-off is made earlier by linking up, an increase of lead is usually preferable to a decrease, and also to the fact that the width of port opening is decreased less rapidly by the open than by the crossed gear.

Again, it is readily seen that as the point *P* passes the middle of the curve and goes to the other side, or, in the actual gear, the link block passes the center of the link and goes toward the other end, the same series of changes with either form of gear will be traversed.

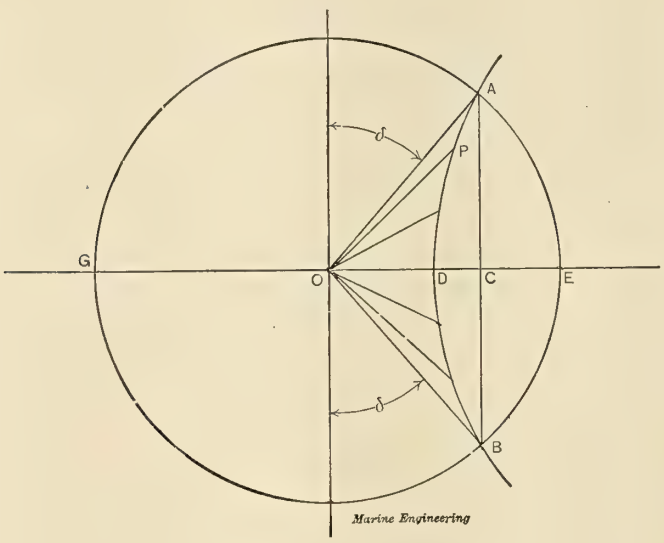


FIG. 24.

and in the opposite direction, ending with a virtual throw and angular advance equal to that of the actual eccentric at the other end of the link *B*. It will be clear, from what has been said in connection with the simple valve gear regarding the direction of rotation, that all locations of *P* between the end *A* and the middle will correspond to rotation in one direction or with an outside valve from *C* toward *A*, while all locations of *P* between the end *B* and the middle will correspond to rotation in the other direction, or from *C* toward *B*.

The application of the Stephenson link as a reversing gear is thus shown, as well as the gradual way in which this is brought about by a continuous change in the characteristics of the virtual eccentric, bringing about changes in the steam distribution as noted above.

The principal characteristics of these two types of Stephenson link valve gear with regard to the effect on the various events, etc., due to linking up the gear, may be conveniently presented in the following tabular form:

STEPHENSON LINK.

EFFECT OF LINKING UP.

Type of gear	Open-rod.	Crossed-rod.
Virtual eccentric throw	Decreased.	Decreased.
Virtual angular advance	Increased.	Increased.
Valve travel	Decreased.	Decreased.
Port opening	Decreased.	Decreased.
Lead	Increased.	Decreased.
Cut-off	Earlier.	Earlier.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports under date of December 9, 1903, the following construction of vessels for the United States Navy:

				Degree of Completion.	
				November 1.	December 1.
BATTLESHIPS.					
No. 11..	Missouri	18 knots	Newport News Co	99 per cent.	99 per cent.
" 12..	Ohio	18 "	Union Iron Works	82 "	83 "
" 13..	Virginia	19 "	Newport News Co	47 "	50 "
" 14..	Nebraska	19 "	Moran Brothers Co	30 "	30 "
" 15..	Georgia	19 "	Bath Iron Works	37 "	40 "
" 16..	New Jersey	19 "	Fore River S. and E. Co.	46 "	48 "
" 17..	Rhode Island	19 "	Fore River S. and E. Co.	47 "	48 "
" 18..	Connecticut	18 "	Navy Yard, New York, N. Y	21 "	24 "
" 19..	Louisiana	18 "	Newport News Co	28 "	31 "
" 20..	Vermont	18 "	Fore River S. and E. Co	0 "	1 "
" 21..	Kansas	18 "	New York Shipbuilding Company	5 "	2 "
" 22 .	Minnesota	18 "	Newport News Co	4 "	8 "
ARMORED CRUISERS.					
No. 4..	Pennsylvania	22 knots	William Cramp and Sons	60 "	63 "
" 5..	West Virginia	22 "	Newport News Co	64 "	67 "
" 6.	California	22 "	Union Iron Works.	43 "	48 "
" 7..	Colorado	22 "	William Cramp and Sons	65 "	67 "
" 8..	Maryland	22 "	Newport News Co	60 "	63 "
" 9..	South Dakota	22 "	Union Iron Works	41 "	44 "
" 10..	Tennessee.	22 "	William Cramp and Sons	10 "	12 "
" 11..	Washington	22 "	New York S. B. Co	8 "	9 "
PROTECTED CRUISERS.					
No. 14..	Denver	17 knots	Neafie and Levy	98 "	98 "
" 15..	Des Moines	17 "	Fore River S. and E. Co	94 "	96 "
" 16..	Chattanooga	17 "	Lewis Nixon	74 "	72 "
" 17..	Galveston	17 "	Wm. R. Trigg Co	68 "	69 "
" 18 .	Tacoma	17 "	Union Iron Works	93 "	96 "
" 20..	St. Louis	22 "	Neafie and Levy	32 "	34 "
" 21 .	Milwaukee	22 "	Union Iron Works	35 "	38 "
" 22.	Charleston	22 "	Newport News Co	53 "	55 "
GUNBOATS.					
No. 17..	Dubuque	12 knots	Gas Engine and Power Co	10 "	15 "
" 18..	Paducah	12 "	Gas Engine and Power Co	9 "	13 "
TRAINING SHIPS.					
.. ..	Cumberland	Sails	Navy Yard, Boston	0 "	7 "
.....	Intrepid	"	Navy Yard, Mare Island	0 "	0 "
TRAINING BRIG.					
....	Boxer	Sails	Navy Yard, Portsmouth	2 "	3 "
TORPEDO BOATS.					
No. 19..	Stringham	30 knots	Harlan and Hollingsworth	95 "	93 "
" 20..	Goldsborough.	30 "	Wolff and Zwicker	99 "	99 "
" 27..	Blakely..	26 "	George Lawley and Son..	99 "	99 "
" 29..	Nicholson	26 "	Lewis Nixon	99 "	99 "
" 30..	O'Brien	26 "	Lewis Nixon	98 "	98 "
" 34..	Tingey	26 "	Columbian Iron Works	97 "	100 "
STEEL TUGS.					
No. 8..	Pentucket	12 knots	Navy Yard, Boston.	90 "	96 "
" 9	Sotoyomo	12 "	Navy Yard, Mare Island	90 "	95 "

ENGINEERING SPECIALTIES.

Electric Steering Gear.

New uses of electricity on shipboard are constantly being found, as described elsewhere in these pages. The application of electricity to steering gear is most recent because of the more or less complicated form of controller which up to date has been required. Herewith is presented and illustrated an electric steering gear patented by Mr. Brougham and installed on the English yacht *Valhalla*.

The mechanical operation is of the type usually fitted on large yachts for hand steering, and has only been slightly altered to allow of electric controller. It consists essentially of a solid cast-iron frame bolted to the deck. The upper end of the rudder post passes through the base of the frame and carries, securely keyed to it, a massive crosspiece, above which and running fore and aft is a right- and left-handed screw supported by the frame and carrying one right- and one left-handed nut, as shown in the engraving. These nuts are supported and prevented from turning by two guides running parallel with the screw, and are connected by links, one to each side of the crosspiece on the rudder post. By this means the turning of the screw operates the rudder. The steering wheel is large enough to be used in emergency for hand steering. It is carried on a sleeve on an extension of the screw, to which it can be connected by means of a claw clutch.

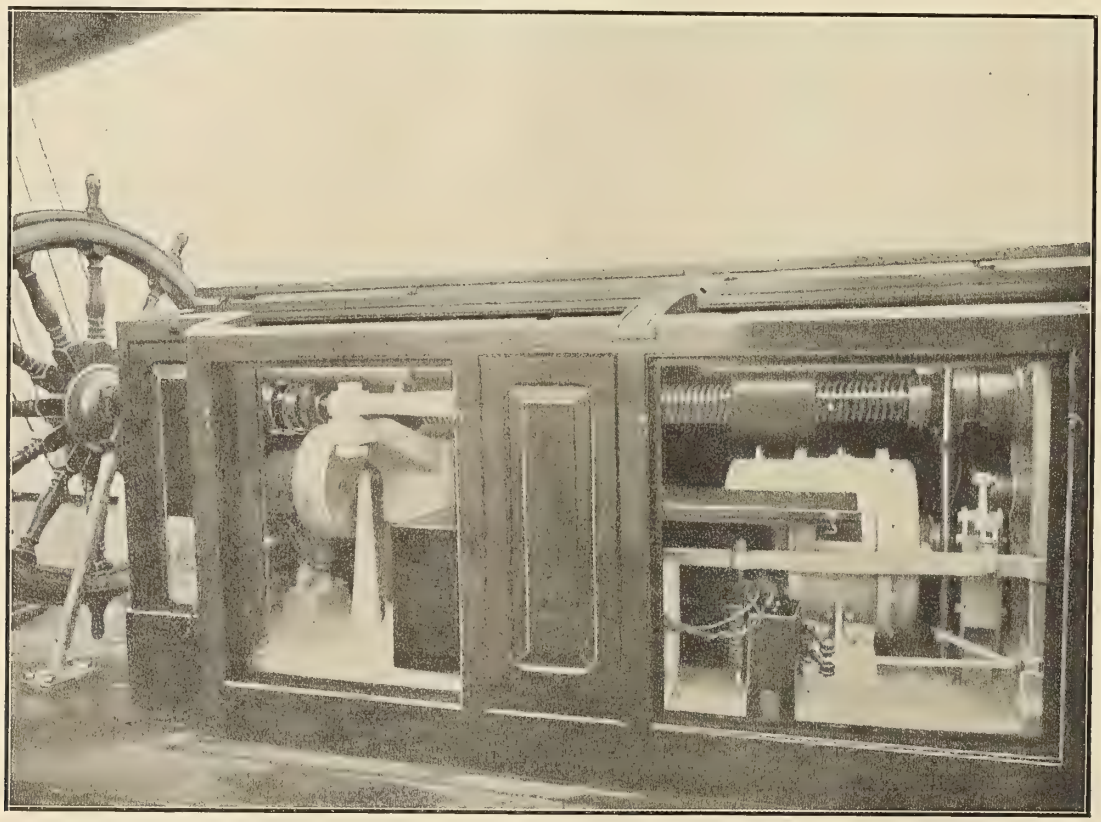
A Siemens 4-pole motor, completely enclosed, is

arranged to drive the screw through several reductions of spur gearing and a claw clutch, which is connected to the clutch on the steering wheel in such a manner that both are operated by one lever and only one can be in gear at a time. It will thus be seen that the screw, which operates the rudder through the nuts and links, may be turned either way by the electric motor or by the steering wheel, but not by both at the same time. The motor is series wound and is provided with a brake pulley and brake blocks which are held off by an electromagnet in series with the motor and held on by a suitable spring. The brake is therefore put on and the motor promptly pulled up whenever the current is interrupted.

The motor is controlled by a special hunting switch with two levers and two sets of contacts, one for each direction of rotation. This arrangement was adopted instead of a single reversing switch in order to get a very reliable quick break action. Each switch has three contacts, so that resistance can be cut out in two steps, and they are so shaped that the actual contact surfaces are not touched by the arcs and therefore remain in good condition. They are reversible and can be easily replaced, the insertion of new ones occupying but a very few minutes. A powerful magnetic blow-out, which operates upon all the contacts, is provided on each switch. Ample precautions against arcing troubles have been taken because of the extremely frequent switching off and on which is required in the ordinary steering of a ship.

The two switch arms are mounted on two pins at equal distances from the center of a metal disk geared to the steering wheel. The second disk is in gear with the screw and its motion is therefore proportional to that of the rudder. The switching on or off is therefore the result of the difference in the motions of the two disks, which are proportional to that of the rudder and the steering wheel respectively.

The gearing is such that twelve complete turns of the steering wheel move the rudder from hard-a-port to hard-a-starboard, a total angular distance of 80 degrees. A Geneva stop, in connection with the second disk prevents the steering wheel from turning more than twelve complete revolutions, and when the second disk is brought to rest by the stop the first catches it up. The motor is thus automatically switched off when the extreme positions of the rudder are reached.



ELECTRIC STEERING GEAR ON THE YACHT VALHALLA.

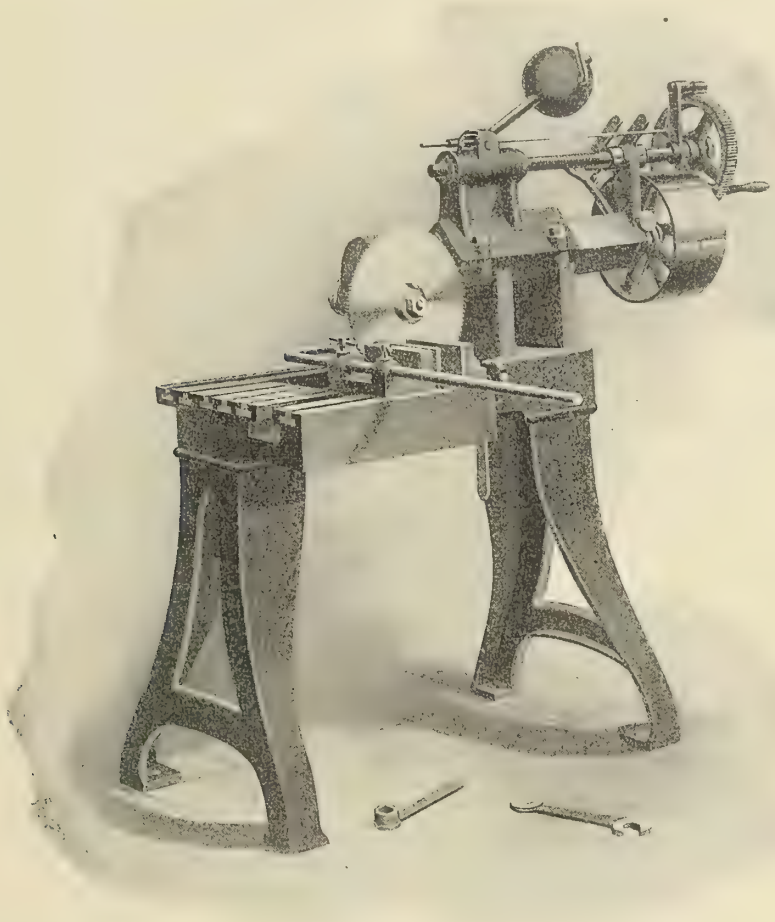
The gear on board the *Valhalla* is stated to have amply proved its efficiency, and given complete satisfaction to the navigating officers, the control of the ship being as perfect as could be desired. The test imposed, which was considered the most severe, namely, throwing the rudder from hard-a-port to hard-a-starboard whilst steaming full speed astern, was accomplished with ease and without excessive consumption of current. When steered by hand the gear requires the combined energies of four or more men, according to the state of the weather.

Complete particulars of this gear may be had by addressing the manufacturers, Siemens Brothers and Company, Limited, 12 Queen Ann's Gate, Westminster, London, S. W.

Cold Saw Cutting-Off Machine.

The accompanying illustration shows one size and style of the Wagner cold saw cutting-off machine, made by the Diamond Drill and Machine Company, Birdsboro, Pa. The machine is next to the smallest size and carries a blade 12 inches in diameter. The saw is mounted in an arbor that is carried in a swivel head secured to the front of the ram. This ram is square in section and travels in a long, rigid guide. The head is graduated and can be swung clear around in a vertical plane and clamped in any position, thus making it possible to cut off the stock at any desired angle. The saw becomes dull and does not cut freely, or the cross section increases, the weighted arm lifts, releases the feed, and prevents the saw breaking or becoming jammed.

A pan is formed in the table for soap water or other lubricant, in which the saw constantly dips. The 12-inch saw will cut rounds up to 3 1-2 inches in diameter. The largest machine, carrying a 40-inch blade, will cut rounds up to 13 inches in diameter. These machines are built with seven sizes of saw blades, and as many as four different styles of bed plates and vises with each style of saw blade. A special study has been made of designing different styles to meet the varying requirements to which this unique cold saw cutting machine can be put. The machine for cutting long I-beams, channels, or heavy shafts is so designed that it is not necessary to turn the work around when it is desired to cut off both ends.



COLD SAW CUTTING-OFF MACHINE.

arbor is driven by means of a phosphor-bronze worm wheel and steel worm, the worm shaft running longitudinally through the ram and carrying on its end tight and loose driving pulleys, thus requiring no counter-shaft.

The feed is positive and is obtained by means of an eccentric on the end of the worm shaft. The feed screw is journaled in a bracket at the end of the ram and runs through a nut which fits freely in a bracket cast on the top of the ram guide. The screw is rotated by a ratchet wheel and pawl. A rack is formed at the top of the feed nut, and meshing with this rack is a pinion to which is attached an arm carrying an adjustable weight. This arrangement makes a very sensitive feed; it is easily regulated by shifting the weight, and when the

Some of the advantages claimed for this machine are: great capacity for speed, minimum wear of saw blade, automatic feed according to variation in shape or hardness of material to be cut; no cessation in cutting, even in case of saws with teeth broken out, etc. It is automatically thrown out of feed when the cut is completed, thus allowing one operator to have charge of several machines.

Water-Tube Boiler.

The four recently-constructed monitors for the United States Navy are each fitted with a different type of water-tube boiler, which is practically the only point of difference, the Mosher boiler being installed on the *Florida*. A comparison of trial results speaks most favorably for this boiler, both in steaming capacity or heating surface and light weight.

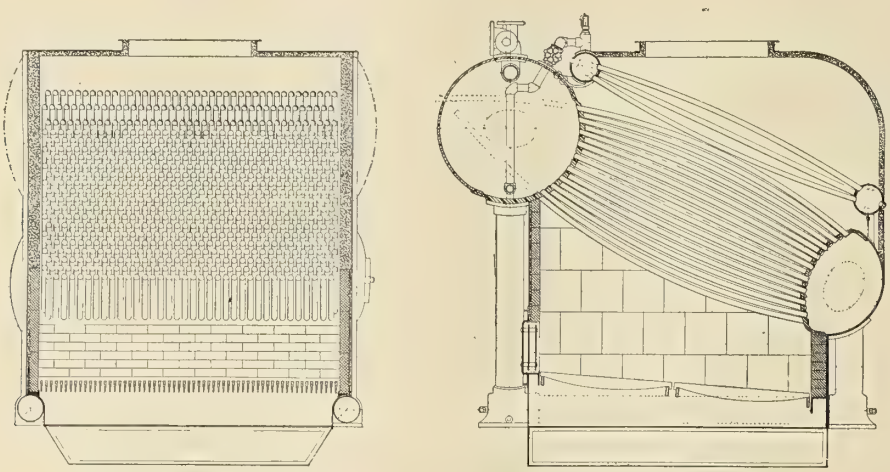
The Mosher boiler consists of four elements, viz.: steam drum, water drum, tubes, and return pipes. These different parts may be seen by referring to the cut. The steam drum is supported at each end by a large return or circulating pipe, with the necessary fittings. The fittings at the bottom are provided with handholes in the front, and at the back two circulating pipes extend forward with the necessary connections for supporting the water drums. The tubes are expanded directly into the steam and water drums and may be conveniently reached for expanding through manholes in the heads of the drums. The tubes are given a slight curve and by the dotted lines it will be seen may be cleaned, withdrawn, or replaced through a single row of handholes in the front portion of the steam drum. As many as five vertical rows, or 45 tubes, may be cleaned, withdrawn, or replaced by removing one handhole cover.

The feed-water heater consists of two steel drums connected by slightly curved tubes which are expanded into them. These drums are fitted with a row of handholes similar to the steam drum of the boiler and are placed out of the path of the gases of combustion, thus preventing the possibility of injury regardless of the amount of scale or sediment that may collect in them. The handholes of boiler and heater are closed by a special plug or cover, which consists of a conical-headed bolt provided with a short piece of copper tube, a washer and nut. The head of the bolt and copper tube may be inserted in the opening (or handhole) from the outside of the drum, after which the nut may be screwed up, thereby flaring the end of the copper tube by drawing the conical head of the bolt into the same, thus forming a steam-tight metallic joint, the pressure always being on the head of the bolt, thereby increasing the tightness of the joint.

These boilers are constructed in standard sizes up to 2,500 square feet of heating surface, and larger sizes to meet any special requirements. The standard boilers are fitted with cast-iron grate bars, but wrought-iron bars may be fitted when required for special service.

By referring to the drawing it will be seen there are no baffles provided for distributing the gases of combustion. This is accomplished by special means in a far more effective manner. The great objection to the usual baffles is well known, as they make it practically impossible to clean the tubes, besides providing shelves or pockets for soot and ashes to collect on, and further they cause the gases to take a diagonal course over the tubes, thus failing to sweep over a large portion of their surface.

Due to structural conditions in most other boilers, and particularly those constructed with headers, it is necessary to space the tubes so far apart that baffles must be used to prevent the gases from taking a direct course to the stack, which would cause a sacrifice of the effective heating surface. Furthermore, if the tubes are spaced a considerable distance apart, they not only allow the gases to pass by without coming in contact with the upper third of their surface, but soot and ashes collect on this surface undisturbed by the gases. In the Mosher boiler most of the tubes are spaced so close together that each tube acts as a baffle for the tube below it and effectually distributes the gases over the entire surface of the tubes, keeping all the tubes swept free from ashes and soot, and thus allowing the full capacity of the boiler to be realized. It is impossible to place the tubes as close together as desired for the purpose of reducing the space between them to approximate that of the stack; the gases therefore would have some tendency to take a direct course to the stack and not pass over the tubes at the end and corner portions of the furnace. This is effectually overcome by the Mosher patent feed-water heater, which, as it is made with small size drums, permits the tubes to be placed sufficiently close together so as to reduce the calorimeter to slightly over that of the stack. As will be seen by referring to the drawing, this heater extends the whole length of the tubes, which it is claimed obliges the gases, in order to

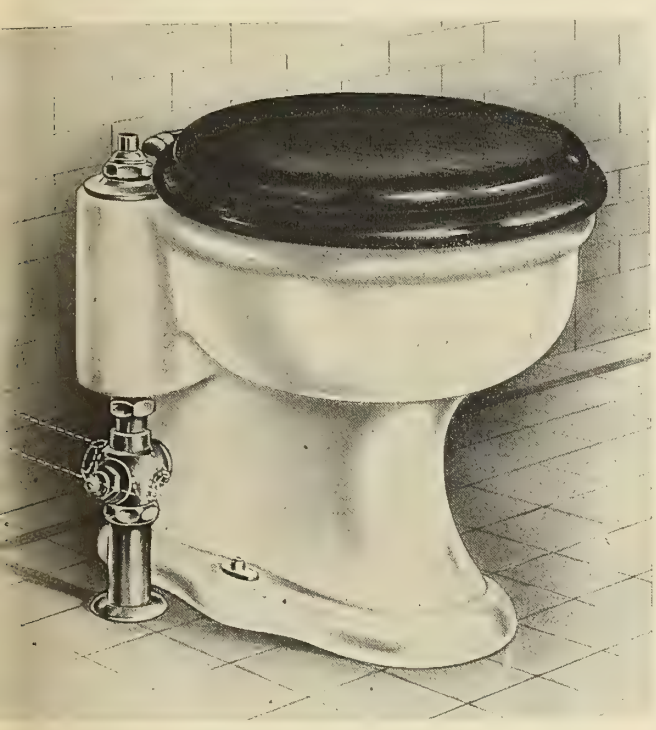


FRONT AND SIDE SECTIONAL ELEVATIONS OF MOSHER WATER-TUBE BOILER.

realize sufficient area for egress from the boiler, to be distributed over all the surface of the generating tubes as well as that of the heater itself.

Another advantage resulting from placing the tubes staggered and close together is that the gases in passing by are "broken up" by them and the maximum amount of heat is transmitted to the heating surfaces.

This boiler is made by the Mosher Water Tube Boiler Company, 1 Broadway, New York, N. Y.



CLOSET WITH SPECIAL COMPACT VALVE.

The Auto Closet.

The accompanying cut is that of a new type of water-closet called the Auto, which is particularly well adapted for use on board steamships because of its compactness, and because it is practically indestructible and dispenses with the individual supply tanks. The valve used to operate this closet is a special form of the Watrous Aquameter, which is now in general use. The valve is entirely closed within the earthenware, which renders it impossible to be tampered with and reduces the amount of nickel-plated work to be taken care of. The closet bowl is of a very heavy siphon-jet pattern and can be operated by direct pipe connection from the supply tank or automatic pump, whichever system may be employed for supplying the water.

For salt-water use the valve is made with glass-lined body, so that no corrosion occurs. A number of these closets, which are made by the Federal Company of Chicago, have been used in marine work by shipbuilders on the lakes and coast.

Resumed Work.—The Townsend-Downey Shipbuilding Company, Mariners' Harbor, N. Y., which went into the hands of a receiver early in December, owing, it is stated, to labor troubles, has resumed work.

QUERIES AND ANSWERS.

Q. 181.—Will you kindly answer the following questions in your valuable inquiry column?

(a) How would you know how to power a yacht like the *Corsair* if you wanted her to make about 20 knots per hour?

(b) Are there any rules in figuring out overhangs, breadth, and draft of such a yacht? W. J. E.

A.—*(a)* There is no rule-of-thumb method for powering, and to decide correctly upon the horse power required to drive the *Corsair* at 20 knots it would be necessary to have full information concerning the lines of this boat, and to be pretty well posted in the performance of other similar vessels; for there are no definite rules, and most of the figuring has to be decided by comparing with other known vessels. The simplest rule is expressed in the following formula:

$$\text{I.H.P.} = \frac{D^{\frac{2}{3}} S^3}{C}$$

in which D = displacement; S = speed in knots; C = constant, which for this class of vessel might be taken in the neighborhood of 200.

The general dimensions of the *Corsair* are: length on water line, 272 feet; breadth, 33 feet 3 inches; depth, 20 feet 6 inches; and draft, 15 feet 10 inches. We do not know the displacement, but can assume it at 2,500 tons. The square of the displacement will then be 6,250,000, and the cube root of this will be 184.2. You have given 20 knots as the desired speed; the cube of this is 8,000; substituting, then, in the above formula, we have:

$$\text{I.H.P.} = \frac{184.2 \times 8{,}000}{200} = 7{,}368$$

(b) There are no definite rules for determining on the overhang, breadth, and draft, but these dimensions vary with the different designers and the service for which the yacht is intended. The *Corsair* represents the Watson design, which is considered the highest type for yachts. The draft will be determined by the service for which the yacht is intended.

Both of these subjects are treated in different books published.

Q. 182.—A tugboat engine is of the following description: vertical inverted, single cylinder of 20 inches diameter of piston and 22 inches stroke; link motion with a piston valve; boiler allowed 110 pounds steam; vacuum 25 inches; cut-off on link at about one-half stroke with one-half turn on throttle valve (globe valve) will make from 95 to 100 revolutions per minute with a tow and uses all the steam the boiler can make with natural draft. The boiler is of the marine-leg, fire-box type, with two furnaces. Length of boiler, 14 feet; width or diameter of boiler, 8 feet; furnaces, 39 inches wide by 6 feet 6 inches; two flues 14 inches and four of 11 1-2 inches, all 4 feet 2 inches long; eighty-three 3 3-4-inch tubes; diameter of main steam pipe, 5 inches; temperature feed water with heater, about 125 degrees.

Would it be a good idea to replace this old engine with a steeple compound of the same stroke? That is, would the boiler steam any better for a smaller cylinder used as a high-pressure, and could steam be kept up with a wide-open throttle? Also, would there be any increase in the number of revolutions? About what size of cylinder would be right, and how would you figure it out to find the right dimensions for a new engine? W. E. S.

A.—To answer this question it is first necessary to figure out the heating surface of your boiler, which we can only approximate, as we are not absolutely sure of the type used. That is, your tubes are 11 feet 6 inches, while the length of flues in furnaces added together

makes but 10 feet 8 inches. The approximate figures for the heating surfaces of them are as follows:

	Square feet.
Furnace	125
8 flues	114
83 tubes	880
Total	1,119

This boiler should have sufficient steam for about a 250-I. H. P. engine at the rate of 4 1-2 square feet per I. H. P. You doubtless would find very much better results by installing a steeple compound, for the cubic capacity of steam to the point of cut-off in your old engine is about 3,450 cubic inches outside the clearance, and the mean effective pressure of the old engine running at 150 horse power is 74 pounds.

Using the same stroke, 22 inches, we find the area of the low-pressure cylinder by formula, as follows:

$$A = \frac{\text{I. H. P.} \times 33{,}000}{P \times L \times N}$$

where A = area cylinder in square inches.
I. H. P. = horse power = 250 in this case
P = mean effective pressure, which we will assume as 40 pounds for this case
L = length of stroke in feet
N = number of strokes, or 95 × 2
33,000 = a constant

$$\text{Then } A = \frac{250 \times 33{,}000}{40 \times 1.88 \times 95 \times 2} = 578 \text{ square inches.}$$

This from the table of areas we find equivalent to a circle of about 27 1-8 inches diameter. Therefore we may assume the low-pressure cylinder to be 27 inches.

Under these conditions a cylinder of 14 inches diameter would be appropriate for the high-pressure, so that we have an engine 14 and 27 inches by 22 inches. The cubic capacity in this cylinder, up to the point of cut-off, which we would now assume to be about 64 per cent., or 14 inches, will be 2,142 cubic inches, or less than two-thirds the volume up to point of cut-off of your old engine. The same amount of work is obtained by increased efficiency through the increased number of expansions. If this engine were installed you would doubtless have no trouble in keeping up your steam pressure with throttle full open and increase the revolutions.

Q. 185.—Which vessel will stand the most air pressure per square inch—a spherical one 1 foot in diameter, or one 2 feet in diameter, each of them made of the same thickness of the same material?

A.—The smaller vessel will stand the greatest pressure, and in the case above it will stand twice the pressure per square inch that the larger one will. Consider a hollow sphere and draw a line upon it dividing it in halves. The bursting pressure at all points of the sphere is the same, and we may learn about it by examining the conditions that exist along this line of division. Now, if the inside is subjected to an air pressure, the tendency will be to stretch and rupture the shell, and the total bursting pressure along the circumferential line will be equivalent to the pressure per square inch, times the effective area, and this effective area equals the area of a circle of the same diameter as the sphere. With a sphere 1 foot in diameter the area will be .7854 square foot, or 113.10 square inches; so that if a pressure of 100 pounds per square inch were applied, then the total bursting pressure would be 11,310 pounds. Now, this pressure is equally distributed at all points of the circumferential line on the shell. As the circumference of the sphere is 3.1416 feet, or 37.7 inches, for each inch of circumferential length there is a stress on the shell of 300 pounds.

Now assume a second cylinder, 2 feet in diameter, similarly placed and divided as the first one, and that the same pressure, or 100 pounds per square inch, be applied on the inside. The total bursting pressure will then be equivalent to the area of the circle whose diameter is 24 inches times 100 pounds, or 452.39 × 100 = 45,239 pounds total. Similarly this lifting pressure is distributed over the total circumference of the sphere, and as the circumference is 2 × 3.1416, or 6.2832 feet, or 75.4 inches, the upward pressure per linear inch is 600 pounds, which is twice as great as the pressure on the smaller sphere.

Thus by applying the same pressure per square inch to each sphere, the resulting bursting pressure in the larger one is twice that of the smaller one, or, in other words, only half the pressure per square inch may be applied to the two-foot sphere as to the one-foot sphere to produce the same bursting pressure.

Q. 186.—I would like to know if I will have to become naturalized before I can get a marine engineer's license. I was born in New Brunswick and moved to Massachusetts when I was 3 years old and have lived there ever since, being 22 years now. My father took out his naturalization papers right after we moved to Massachusetts. C. J. T.

A.—Only citizens of the United States are eligible for examinations for marine engineer's license. Under the laws of naturalization, if the father takes out naturalization papers before the son is eighteen years of age, the son becomes a citizen of the United States. So, as your father took out such papers when you were a boy, you are legally considered a citizen of the United States and are therefore eligible for examination.

Q. 187.—I wish you would settle the following point. In your July number you have the supplement of a 3-cylinder, direct-acting, triple-expansion engine. M. J. says that the piston designed like that high pressure has more area than a piston of the old style and more power for its size. I say that it has no more power than the old style, although it has more sectional area. I claim that the new area makes for strength and lightness. Please set us right. E. O. M.

A.—You are right and M. J. is wrong. The power of an engine depends on four factors: first, length of stroke; second, pressure on the piston; third, number of strokes; and fourth, the area of the piston. By the area of the piston is meant the projected area, or that equivalent to a flat piston, and the thickness and shape of the piston have nothing whatever to do with the power. The cone shape is used because it makes a very strong piston.

For finding the I. H. P. of an engine use the following formula.

$$\text{I. H. P.} = \frac{P \times L \times A \times N}{33{,}000}$$

The meaning of the terms is given in the answer 182.

Q. 188.—Kindly publish through your paper the following: What would be the horse power of a cross-compound engine, 11 1-8 inches high-pressure and 24 1-2 inches low-pressure, with a common stroke of 4 feet 8 inches, making 24 revolutions, boiler pressure 150 pounds, 5-8 cut-off on high-pressure cylinder and working full stroke on low-pressure cylinder, 3-4-inch clearance in cylinders, rods 2 1-4 inches and 2 3-4 inches? This arrangement is to be worked on a western river steamboat, engines condens-

ing. An approximate calculation will do. Would also like to have any suggestion you may see fit to make. What will be the difference in horse power developed in each cylinder?

PITTSBURG.

A.—By making certain assumptions the answer to this question may be found similarly to that in Q. 182, or by using other formula the following solution may be carried out:

Cutting off at 5-8 stroke in the high-pressure cylinder and expanding to full low-pressure cylinder gives a total number of expansions of 7 3-4; this is found as follows: By dividing the cubic capacity of the low-pressure cylinder by the capacity of the high-pressure up to the point of cut-off. In other words,

$$\frac{471.4 \text{ sq. ins.} \times 56 \text{ ins. (stroke)}}{96.8 \text{ sq. ins.} \times 56 \text{ ins.} \times 5\text{-}8} = 7.73, \text{ say } 7\ 3\text{-}4.$$

With gauge pressure of 150 pounds at boiler, that at engine valve would be about 143 pounds. Then the mean effective pressure, P, for this ratio of expansion, $r = 7.75$, is solved from the formula

$$P = p_1 \frac{1 + \text{hyp. log } r}{r}$$

where p_1 = the absolute initial pressure, which in this case is 143 + 14.7 pounds = 147.7 pounds, say 158.

The expression at the right is found from tables given in practically all steam engineering books to be .3939, and substituting, $P = 158 \times .3939 = 62.2$ pounds.

Thus, if the full theoretical power of the steam expanding from the initial pressure down to a vacuum were available, the mean effective pressure reduced to the low-pressure cylinder would equal 62.2 pounds. Because of condensation, compression, dividing into two cylinders, etc., the actual pressure is only a certain percentage of this, the per cent. being called the card factor. With your engine the factor .68 would be about right, which would give a value of 42.3 pounds. From this the I. H. P. may be found from the usual formula:

$$\text{I. H. P.} = \frac{P \times L \times A \times N}{33{,}000}$$

Substituting for these values in the above formula we have:

$$\frac{42.3 \times 4.75 \times 471 \times 50}{33{,}000} = 143 \text{ I. H. P.}$$

Regarding suggestions, would advise that if your receiver from the high- to low-pressure is very long, you steam-jacket it. While it is the custom on western rivers to run the engines at slow revolutions, if the diameter of the wheels were somewhat reduced, so that the revolutions could be increased, more power would result from the same engine. Your speed of revolutions, however, seems to be about as high as any in practice. To divide up the power equally between the cylinders, it may be necessary to adjust the valves on the exhaust to the high-pressure, and the cut-off on the low-pressure. If you follow for full stroke on the low-pressure, you may find that the admission pressure in this cylinder is too low. This can be remedied by cutting off earlier in the stroke. A receiver pressure of about 20 pounds would doubtless be an approximation to the correct one. This question, however, can be best settled after the engine is built, by putting the indicators on the cylinders and taking cards off.

Q. 190.—In the October number, in Mr. McLane's article on the Template System, I beg to ask if you will advise how this may be carried out for applying to ships' plating? B.

A.—We have asked the author of the above article to reply to this question.—ED.

To lay off shell or inner bottom plating with molds, a mold about the size of the average plate you wish to lay off is required; the cross strip for frame spacing must be spaced accurately and be perfectly square with the edge of the mold. Short frame and seam battens will also be required. The frame batten is made from the corresponding section of the mold that is used to lay off the shell flange of the frames. The seam batten is made the length of one frame space, additional battens being made for butts at end of plates and where the adjacent strakes butt on the plate which is being laid off. All battens must be spaced off with dividers, so that the holes will be universal. There will also be a mold for butt holes, from which the butt straps may also be laid off.

As an example we will take a plate, *ABCD*, Fig. 2, forward of the lowest point in the sheer; let it be an outside plate in the sheer strake six frame spaces in length. Upon the frame batten mark the sheer heights at side of ship from the sheer pole, taking care to place them on the batten inverted. Fig. 1 shows frame batten

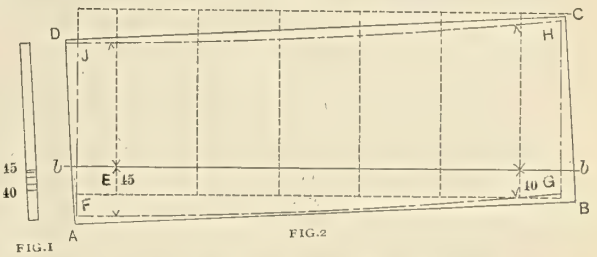


FIG. 1 FIG. 2

and sheer heights for one plate. The dotted lines in Fig. 2 show position of plate mold after being adjusted on the plate, and the dash dot lines the size of the final plate.

Proceed to lay off the plate by placing a spot on after end of plate at *E;* the distance from edge of plate to be equal to distance from 40 to 45 on frame batten plus a small amount as allowance for shearing, etc. Place plate mold on the plate holding the lower edge of mold to mark *E* on after end of plate, and to edge of plate at forward end. Then at a distance equal to the length of frame mold from the lower end to 40, strike a line, *bb*, parallel to lower edge of plate mold. Mark frame and butt stations across the plate by marking along the forward edge of frame station strips and remove mold from plate. The frame batten is now applied to the frame stations on the plate, holding 45 on frame batten at 45 *b*, marking frame holes and ends of batten. Mark remainder of frames on the plate in the same manner.

A long batten is now sprung through the marks made at the ends of frame batten and a fair line marked in, giving the outline of the finished plate *FGHJ;* the seam holes are now marked holding the seam mold to shearing line and frame stations. The butt holes are also marked from butt mold.

Only plates of slight curvature have been treated in this article; for laying off plates of much twist some complications arise requiring much care.

Q. 191.—Would you kindly advise me through your Queries and Answers column:

(1) Which is the right flag for a ship built and used in American waters, but owned by a foreigner?

(2) Is it required by law or by the insurance companies that the sailing master and the engineer of a 50- or 60-foot power launch should be licensed persons, and how are those licenses to be obtained? R. M. P.

A.—The ship mentioned in (1) has a right to American registry. If owners prefer, they can apply for registry under a foreign flag, and most any other government would give her registry if the proper application were made out and filed with said government.

It is required by this government that the engineer of your boat should have a United States license. This is obtained through the United States Steamboat Inspection Service, Bureau of Commerce and Labor, Washington, D. C. No master's license is required.

Q. 192.—Will you please figure out the horse power of a triple-expansion engine, with cylinders 12, 15, and 18 inches diameter by 16 inches stroke? The steam pressure is 185 pounds. Also, how many revolutions will the engine make? H. F. H.

A.—In the first place, your engine has an unusual ratio of cylinder diameters, the area ratio of high- to low-pressure being only about as 1 to 2 1-4, instead of about 1 to 6 or 7 as is usual. Thus the advantage of the three cylinders is lost, and you might as well take out the intermediate cylinder. It is impossible to state what revolutions you would get out of the engine, as that entirely depends on how high a piston speed it was designed for, whether a sufficient supply of steam is at hand, and the size and pitch of your propeller. In the absence of information on this, we will assume that the engine makes 150 revolutions. We also assume that it is run condensing and that the cut-off in the high-pressure cylinder is about 3-8 stroke. This early cut-off we suggest in view of the large high-pressure cylinder.

For finding the ratio of expansion and the mean pressure we will follow the solution of Q. 188. We find that this would give about six expansions, $r = 6$. Assuming that there is a drop of 8 pounds from your boiler to steam chest, the absolute initial pressure, p_1, is $185 - 8 + 14.7 = 191.7$, say 192 pounds.

$$P = p_1 \frac{1 + \text{hyp. log } r}{r}$$

From the table we find that for the ratio of expansion of 6 the reduction factor for mean effective pressure is .4653, and by substituting gives $P = 192 \times .4653 = 89.3$, the theoretical mean effective pressure. We assume that the card factor in this arrangement is only .55, which reduces the mean effective pressure to 49.1. Then using the formula for horse power we have:

$$\text{I. H. P.} = \frac{49 \times 1.33 \times 254 \times 150 \times 2}{33{,}000} = 151$$

TECHNICAL PUBLICATIONS.

The Practical Engineer Electrical Pocket Book and Diary for 1904. Size 5 1-2 by 3 1-2. Pp. 350, with 64 pages for diary on ruled sectional paper. Gilt edges, flexible cover. Price 1s. 6d. Technical Publishing Company, Manchester, England.

This book contains a good selection of engineering tables, formulæ, data, memoranda, and miscellaneous information which the electrical engineer is liable to need at any and all times, and also much special information on this subject. It embraces several articles on various conduit systems of wiring, on the comparative expense of operating hydraulic and electric elevators, and recent installations relating to new types of electric instruments.

The Gas Engine. By T. R. Hutton. Size 6 by 9 inches. Pp. 483, with 243 cuts and diagrams in the text. New York: John Wiley and Sons. Price $5.00.

This work is intended by the author to deal with that part of power-plant practice involving the use of gas engines. It is thus intended to form a companion volume to the author's previous work on the "Mechanical Engineering of Power Plants," from which a consideration of this part of the field was purposely omitted.

During the past few years there has grown up a largely increased appreciation of the possibilities of the internal-combustion engine of one type or another, and in particular of those types intended to utilize what were formerly called the waste gases from blast furnaces and the various grades of producer gas. The astonishing growth of small high-speed engines for use in automobiles and small boats is also an important aspect of the present movement in this field of engineering.

These facts the author has fully appreciated, and the work is therefore most timely, as a clear and fairly comprehensive treatment of the present condition of both the science and art of gas-engine design and operation.

In connection with design, however, it should be noted that the author purposely omits all consideration of the design of the gas engine as a mechanism. He believes that the general papers of machine design and the excellent treatises in this field cover sufficiently this part of the ground, and that he may better utilize his time in the consideration of the gas engine simply as a prime mover. The starting point is naturally the liberation of energy in the form of heat by the combustion of fuel, and the conversion of that heat energy into mechanical work. The cycle of operations which the heat medium undertakes, and the types of motor in which these various transformations occur, are considered in detail with special reference to the various kinds of fuel which may be employed. Consideration is then given to the details of mechanically mixing the fuel and the art of bringing about ignition, and the governing or controlling the development of energy in the cylinder in accordance with the demands for external work. Statements of the economic performance of the best designs of modern gas engines as determined by laboratory experiments are also included. In chapter xvii. is presented a very full theoretical analysis of the operation of the gas engine under all practicable forms of cycle. This forms the most comprehensive investigation of the subject from a theoretical point of view which has yet been published, and gives in convenient form large groups of formulæ suitable for almost every practicable case.

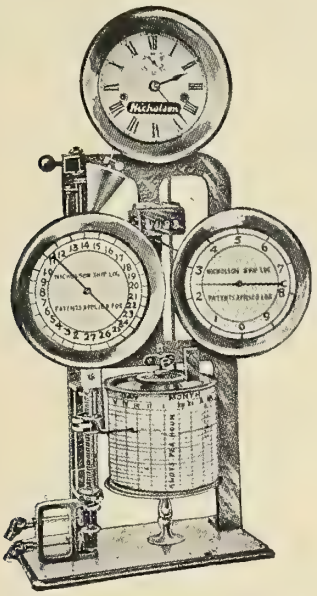
Attention is also given to the possibilities of the type of internal-combustion engine in which the heating takes place at constant pressure rather than at constant volume. The possibilities of the development of the gas turbine as a realization of this type of engine finds appropriate consideration in this chapter.

The book concludes with a brief historical summary of the development of the gas engine, together with a bibliography of the more important works on the subject.

As a whole the book is well written, the material is selected with good judgment, and it will form a most acceptable addition to the working library of every engineer who is interested in this field of power-plant practice.

SELECTED MARINE PATENTS.

742,215. SHIP'S LOG. EZRA NICHOLSON, LAKEWOOD, OHIO.



Claim.—1. In a ship's log, the combination with two pipes communicating with the water below the water line of the vessel, a float in each of said pipes, and a counterweight attached to each float, of indicated mechanism comprising a frame or support, a screw-threaded shaft operatively connected with one of the floats, a nut upon said shaft, a ring longitudinally movable in the frame and engaged by said nut, a sleeve upon the shaft and rotatively connected with said nut, and connections between said sleeve and the other float.

2. A ship's log, comprising means for admitting a column of water within a vessel so that the height of said column shall vary with the speed of the vessel, means for admitting a second column of water within the vessel so that the height of said column shall vary as the draft of the vessel, a screw-threaded shaft, a float on one of said columns operatively connected with said shaft to rotate the same as the height of the column changes, a disk upon said shaft, and a float on the other water column operatively connected with said disk, whereby the disk is moved lengthwise of the shaft proportionately to the relative variation of the heights of said water columns. Four claims.

742,216. SHIP'S LOG. EZRA NICHOLSON, LAKEWOOD, OHIO.

Claim.—1. In a ship's log, the combination with distance-registering mechanism, of a cone, means to rotate said cone regularly, a rotatable shaft operatively connected with said mechanism, a friction wheel operatively engaging said cone and rotatively mounted on said shaft, a sleeve on said shaft secured to said friction wheel, an arm connected with said sleeve for moving same lengthwise of the shaft, mechanism operatively connected with said arm whereby the sleeve is raised and lowered on the shaft the same distance for corresponding increases in the speed of the vessel. Seven claims.

742,326. MINIATURE OR TOY SUBMARINE BOAT. ALEXANDER F. HUMPHREY, ALLEGHENY, PA., ASSIGNOR OF ONE-HALF TO CHARLES R. BUCHHEIT, PITTSBURG, PA. Three claims.

742,450. LIFTING APPARATUS FOR RAISING OR LOWERING CANAL BOATS, ETC. RUDOLF KRELL, NUREMBURG, GERMANY, ASSIGNOR TO THE FIRM OF VEREINIGTE MASCHINENFABRIK, AUGSBURG UND MASCHINENBAUGESELLSCHAFT, NURNBERG A. G., NUREMBURG, BAVARIA, GERMANY.

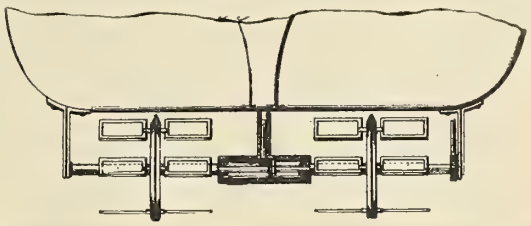
Claim.—1. In an apparatus for raising and lowering canal boats and the like, the combination with a framework, water troughs, and means for supporting said framework floating in said troughs, of drums mounted opposite one another in said framework and adapted to receive the boats or the like directly, and sluice gates completely closing the ends of said rolling drums, whereby the drums may be brought into communication with the canal troughs or may be closed completely at the ends. Two claims.

742,522. PROPELLING MECHANISM FOR VESSELS. TELEMAQUE T. TIMAYENIS, BOSTON, MASS. FILED MARCH 16, 1903. Four claims.

742,529. CURRENT WATER MOTOR. WILLIAM H. TRENCHARD AND FRANK HEATH, JAMUL, CAL. FILED JANUARY 13, 1903. Four claims.

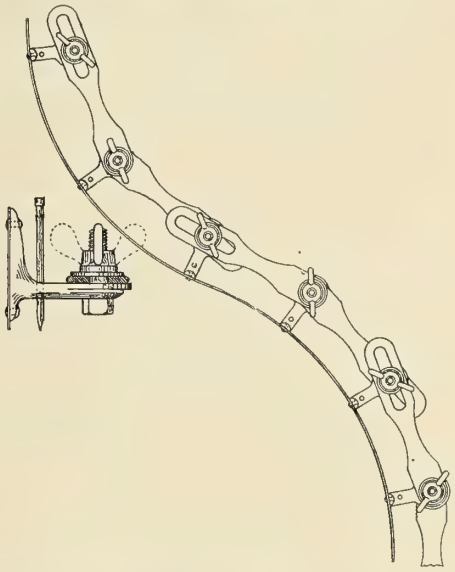
742,693. MARINE PROPELLER. CAREY A. MANKER, PEARL, ILL.

Claim.—1. An improved propelling mechanism comprising a central horizontal shaft, and rotatable blade carrier mounted thereon, blades journaled in said carrier, means for rotating them on their axes as they revolve bodily around the shaft, whereby their angles are varied as required, and means for retarding or accelerating the velocity of rotation of the blades in their down-



ward movement as compared with their upward movement. Four claims.

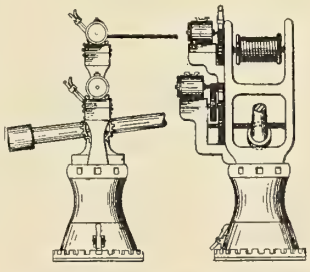
742,937. ADJUSTABLE TEMPLET FOR SHIPS' CARPENTERS. THOMAS B. WAY, JERSEY CITY, N. J.



Claim.—The combination of the flexible band, provided with brackets rigidly secured thereto, each bracket provided with a perforation at its extremity, and perforated for the adjusting pin, the links each perforated at one end, and provided with a longitudinal slot at the other, and the fastening bolts each inserted through the perforation of one of the brackets and all serving to rigidly connect the links in series by means of the perforations and slots therein, and such series to the brackets. One claim.

743,055. WATER MOTOR. LARS E. BOOVIST, SEATTLE, WASH. FILED MAY 9, 1902. Five claims.

743,081. MINE OR SUBMARINE-BOAT DESTROYER. ALEXANDER F. HUMPHREY, ALLEGHENY, PA., ASSIGNOR OF ONE-HALF TO CHARLES R. BUCHHEIT, PITTSBURG, PA.



Claim.—1. In a mine and submarine-boat destroyer, the combination with a rotatable capstan, a supporting frame mounted on the capstan, shafts journaled therein, a boom arm mounted on one of said shafts and extending outwardly from the boat, means

connected with the other of said shafts and passing over said arm for supporting a torpedo, and means for actuating said means to raise and lower said torpedo. Four claims.

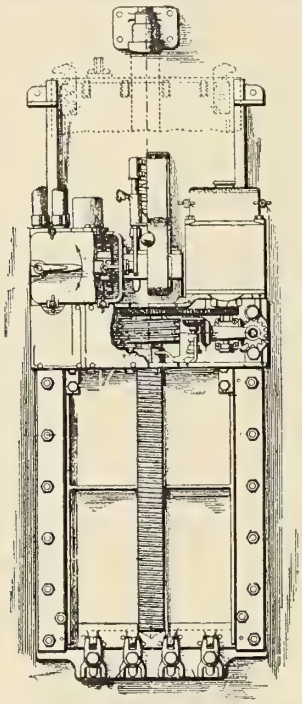
743,167. APPARATUS FOR LOADING VESSELS. CHRISTIAN J. INGARD, PORT TOWNSEND, WASH. FILED MAY 21, 1903.

Claim.—1. An apparatus for loading vessels comprising cables extended lengthwise of the vessel, a frame movable along said cables, and a sling movable on said frame transversely of the cables. Seven claims.

743,171. VESSEL. WALTER G. JAMIESON, UNION HILL, N. J. FILED MARCH 7, 1903.

Claim.—1. A vessel the hull of which is provided at the bow with a tube which is located longitudinally therein and the front end of which opens outwardly and forwardly through the cutwater below the water line, and the rear end of which opens downwardly and backwardly through the bottom portion of the hull at the bow end thereof. Three claims.

743,252. APPARATUS FOR OPERATING WATER-TIGHT POWER DOORS OR HATCHES. WILLIAM B. COWLES, CLEVELAND, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE CLEVELAND TRUST COMPANY, TRUSTEE, CLEVELAND, OHIO, A CORPORATION OF OHIO.



Claim.—1. In a system of the character described, the combination with a sliding door or hatch with a rack secured thereto, of a shaft capable of longitudinal movement when subjected to a longitudinal pressure, a gear wheel fast on said shaft and engaging said rack, an electric motor and gearing for driving said shaft, and an automatical cut-out operated by the longitudinal movement of said shaft for cutting off the current from the electric motor when the load on the motor exceeds a predetermined limit. Two claims.

743,265. ROWLOCK FOR BOATS. ALFRED FENWICK, SUNDERLAND, ENGLAND. One claim.

743,526. FOLDING BERTH. JOHN P. LEIN, NEW YORK, N. Y.

Claim.—In a folding berth, the combination with two fixed brackets having each a straight guideway and a headed trunnion projecting toward each other, of a berth frame having at each end a hanger comprising arms attached to the berth frame, and a web supported by the arms, said web having a curved T-shaped slot extending upwardly from the bottom and toward the rear of the berth frame, said T-shaped slot enclosing the head of the trunnion. One claim.

743,599. SHIP'S AIR AND LIGHT PORT. THOMAS UTLEY, LIVERPOOL, ENGLAND.

Claim.—1. In a ship's light and air port the combination of a hinged frame or shutter, means for enabling said frame or shutter to be shifted bodily in a direction approximately at right angles to the plane thereof, and means for locking said frame or shutter in its open position. Ten claims.

743,700. APPARATUS FOR PROPELLING AND STEERING VESSELS. JOSEPH DUPUIS, WOONSOCKET, R. I., ASSIGNOR OF ONE-HALF TO JOSEPH O. GIGUERE.

Claim.—1. In a propelling and steering apparatus for vessels, the combination of the hull of a vessel, a vertically-disposed sleeve fixed in the stern portion of the hull, an axially-movable, hollow post snugly fitting in the sleeve and having a flange disposed above the upper end of the same, anti-friction devices interposed between the flange of the post and the upper end of the sleeve, a shaft journaled in the lower portion of the hollow post, and carrying a propeller, and means, arranged in the hollow post, for transmitting motion to said shaft. Two claims.

743,721. MARINE LIFE-PAIL. HENRY H. HERRENDEEN, MUSKEGON, MICH.

Claim.—1. As a new article of manufacture, a marine pail adapted to serve as an ordinary pail as well as a life preserver, said pail being provided with an air chamber and a handle to serve as a hand-grasp at the bottom thereof. Four claims.

743,816. RECREATION SUBMARINE-BOAT DEVICE. FRANCIS W. BRADY, ENGLEWOOD, N. J., ASSIGNOR TO ELECTRIC BOAT COMPANY, NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

Claim.—1. The combination, with a submergible boat, provided with means for closing it against the ingress of water to its inhabited part, with means for steering and propelling it, and with laterally-projecting parts to facilitate diving, of a guideway wholly submerged, having guides adapted to engage and take over the said laterally-projecting parts on the boat and draw the latter, as it advances, down under the water, said guideway thus having its entrance below the surface, so as to be invisible to spectators. Five claims.

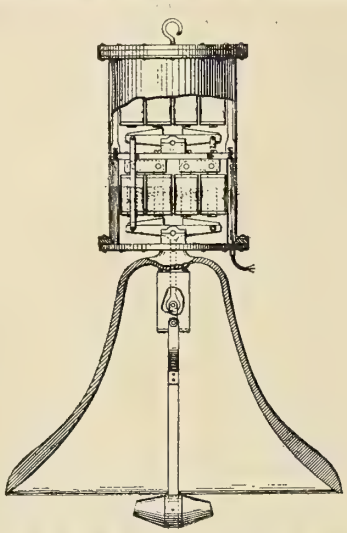
743,939. SAFETY-ALARM DEVICE FOR MARINE VESSELS. MARSHALL SHEPARD, EDGARTOWN, MASS.

Claim.—1. An alarm device for marine vessels, comprising an electric alarm, an electric circuit in which the alarm is located, a circuit closure in the vessel, a rod having swinging connection with the vessel, and a swivel-like connection between said rod and the circuit closure.

5. An alarm device for marine vessels, comprising a casing arranged in the hull of the vessel and opening therethrough, a valve for closing said casing, a cylinder removably arranged in the casing, a thimble arranged in the cylinder, a contact on said thimble and insulated therefrom. Five claims.

744,160. MEANS FOR TURNING OR SWINGING SHIPS WHEN NOT UNDER WAY. JOHN B. BLAIR, INDOOROPPILLY, QUEENSLAND, AUSTRALIA. Two claims

744,336. ELECTRICAL RINGING OF BELLS FOR SUBMARINE SIGNALING. ELISHA GRAY, HIGHLAND PARK, Ill., ASSIGNOR, BY MESNE ASSIGNMENTS, TO SUBMARINE SIGNAL COMPANY, A CORPORATION OF MAINE.



Claim.—1. As a means for producing in water sound-wave signals of high power for long-distance, submarine, wireless telephony, a submerged bell of large initial sound-producing capacity, a submerged hammer for powerfully striking the bell, each stroke of which is controlled, a submerged electric motor of large force to actuate the hammer in operative relation to the bell and hammer, the bell being in actual contact with the water. Five claims.

744,378. MEANS FOR CANAL-BOAT PROPULSION. GILBERT H. MANN, ZOAR, MASS. Six claims.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 90 vessels of 43,711 gross tons were built in the United States and officially numbered during the month of November, 1903. The largest steel steam vessels included in these figures are: *Mongolia,* 13,638 tons; *San Jacinto,* 6,069 tons; *J. L. Weeks,* 4,551 tons; *Lewis Luckenbach,* 3,905 tons; *Pere Marquette 19,* 2,626 tons; (sail) *William C. Douglas,* 3,708 tons.

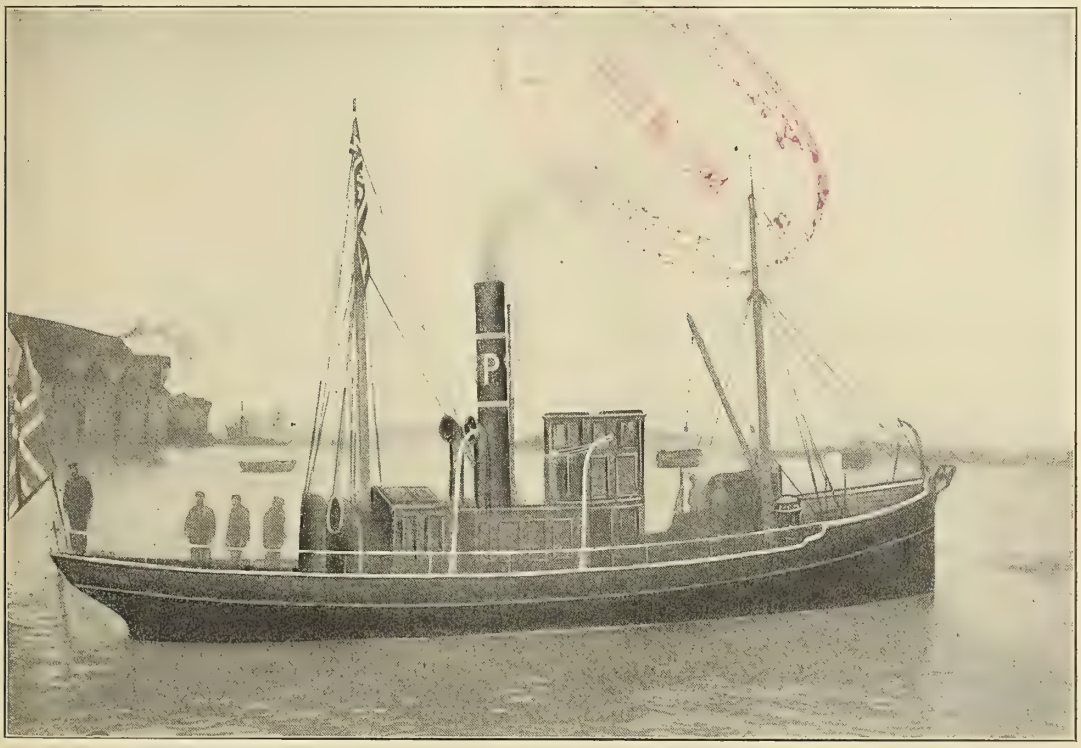
INDEXED.

Marine Engineering

Vol. IX. NEW YORK, FEBRUARY, 1904. No. 2.

NORWEGIAN FISHING STEAMER.

The following description and illustrations show the latest type of the smaller 75-foot Norwegian fishing steamers, as used on the western and northern coast of Norway for fishing in home waters. Boats of this class are built very heavy and strong to stand the heavy weather encountered in the northern seas. From October to February they are fitted out with nets for herring fishing, and the rest of the year for line fishing after halibut, codfish, and haddock.



NORWEGIAN FISHING SCHOONER MJOLNER; USED ON THE NORTH SEA.

The principal dimensions of hull and machinery are given on the data card, while the half-tone and drawings show the construction and arrangement of the hull and machinery. They are single flush-decked vessels, and are classed A1 under Det Norske Veritas, built of steel throughout. The two pole masts are fitted with leg-of-mutton sails, foresail, mainsail, and jib, and the foremast has one derrick for handling cargo.

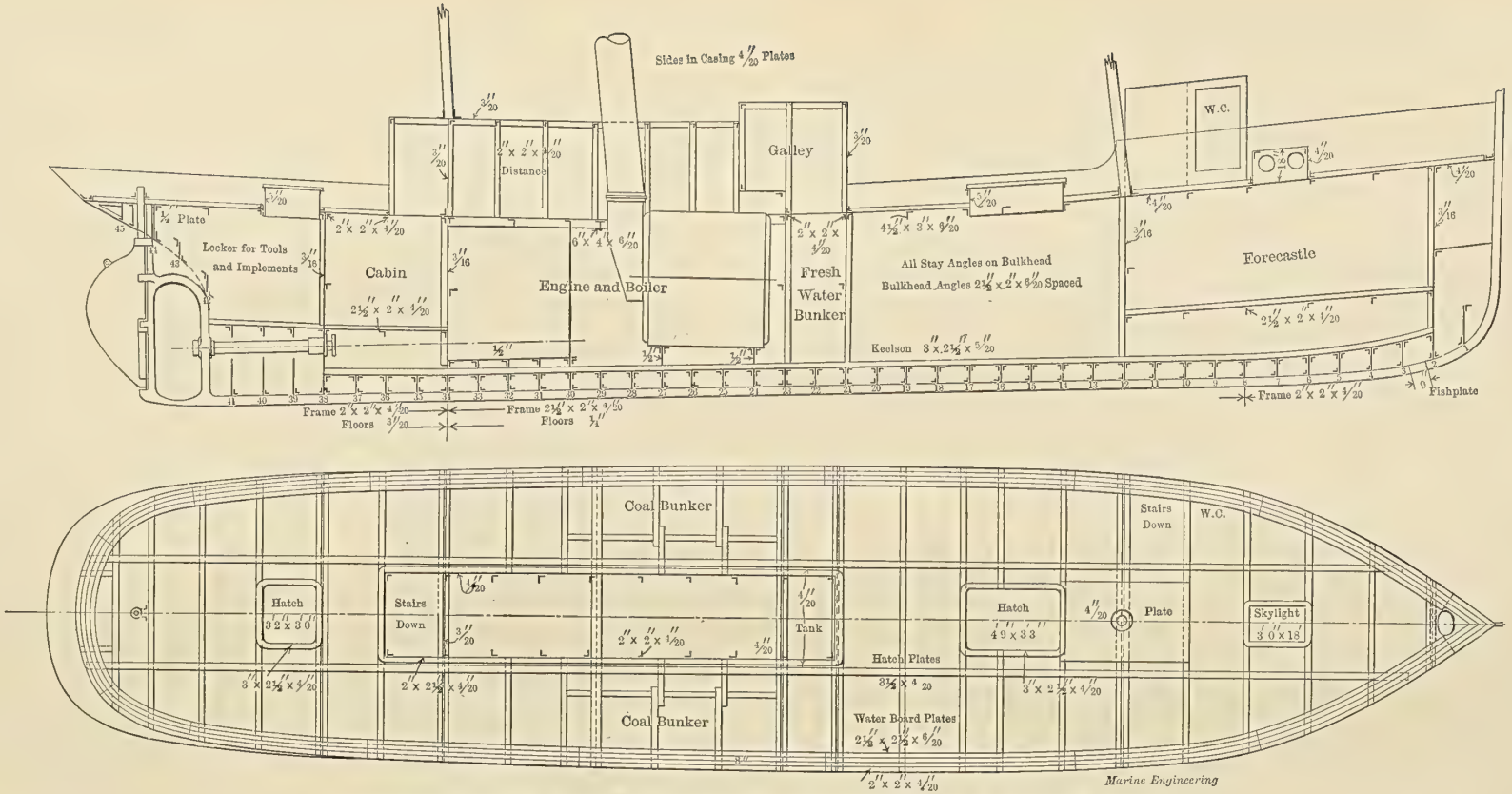
The bar keel is 4 3-4 by 7-8 inches, the frames 2 1-2 by 2 by 4-20-inch angles spaced 19 inches. The reverse frames are 2 by 2 by 4-20 inches. The stem and stern post of forged steel. Rudder head 2 7-8 inches diameter. At the bow on the water line the framing is strengthened about 20 feet aft with shorter frames worked in between the others according to the rules for ice protection. The shell plates are also 1-16 inch thicker on this part.

Besides the forward and aft collision bulkheads there are three water-tight bulkheads of 1-4-inch steel plates extending to deck. Bunkers with the capacity of 14 tons of coal extend athwartship forward boiler, and with two wing bunkers on each side of boiler carried so far aft as possible.

The plating is laid in inside and outside strakes as shown. The bulwarks are carried 20 inches above deck, increasing to 36 inches at forward end, and are topped by special heavy rail iron 4 by 2 by 3-8 inches. A 2-inch half-round iron is carried all around the vessel at the deck line. On the starboard side are two similar irons at water line and below, to act as fender and leads for fishing lines. At the bow are similar fenders on both sides for anchor chains.

The deck is laid with Norway pine 2 1-2 by 4 inches, and is fitted with four pairs of bitts, chocks, and cleats.

(Copyright, 1904, by Marine Engineering, Inc., New York.)



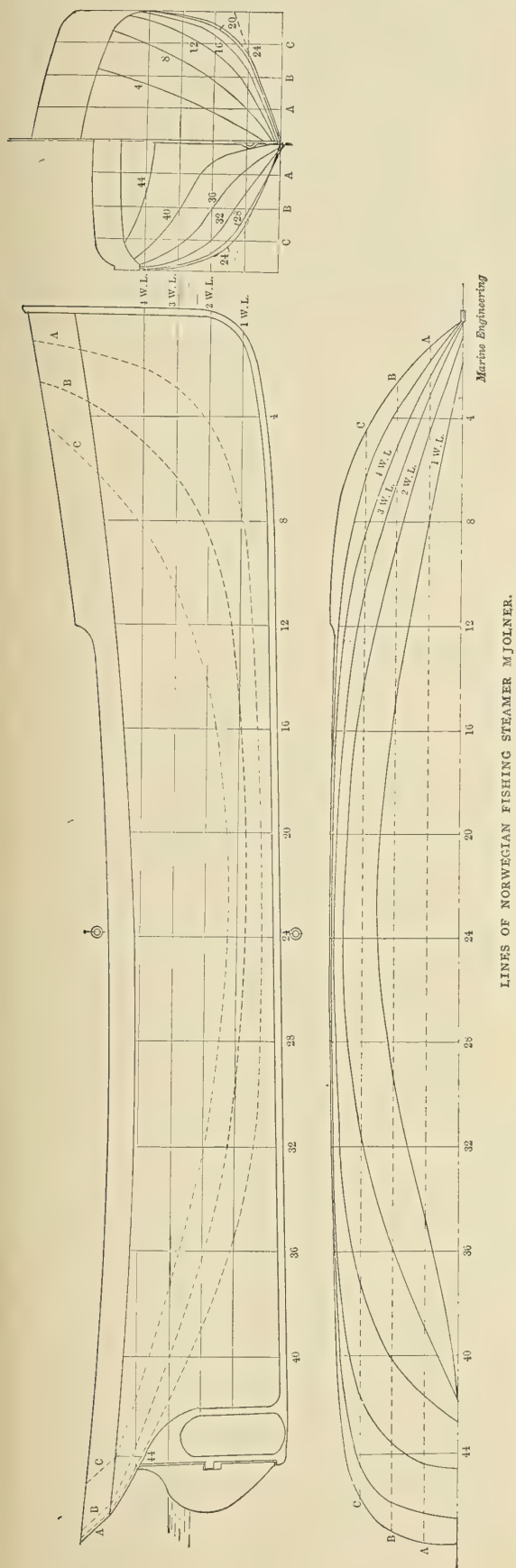
LONGITUDINAL AND DECK PLANS OF A NORWEGIAN FISHING STEAMER, BUILT AT STAVANGER, NORWAY.

Forward the foremast is a vertical steam-driven capstan, which is used both for hoisting the anchors and hauling the cable for the fishing nets. The anchors are 350 pounds, without stocks, of the common old-style, as these are considered the safest by the fishermen. At the bow there is one anchor davit and a set of rollers of novel design over which the fishing cable is hauled in. On starboard side is another set of rollers for ordinary fishing lines.

Over the engine and boiler room is built a steel casing 4 feet wide, carried 5 feet above the deck, with engine skylights and entrance doors on each side. At forward end of this is the galley, and above this the wooden pilot house, 5 feet 9 inches long, 4 feet wide, and 6 feet 2 inches high. In the pilot house are the hand-steering gear, spirit compass, engine telegraph, and a patent chart case which in a convenient manner keeps the charts free from wear and tear. Aft of the casing is the entrance to the cabin and the lantern locker. In the deck house forward on port side is the entrance to the forecastle and the water closet.

The crew's quarters are 16 feet long, and here are berthed eight fishermen, one fireman, and one cook. It is pretty well ventilated and lighted, but rather small. In the cabin aft are accommodations for the captain and the engineer. The fittings are plain but neat, and as comfortable as the place allotted will allow. Over the gutters are laid grating of 3-4 by 5-16-inch convex irons, with 1-2-inch space, so no fish (especially herring) can fall down in the gutter and go overboard through the scupper holes.

One 16-foot dinghy is carried, and six dories are stowed on deck when the boats are employed in cod, halibut, and haddock fishing. There are three boat davits, two starboard and one port. There are also hoisting tackle from the masts for taking in the dories. Aft of the cabin is a store room for fishing nets and lines. The main hold is carefully isolated on the bulkheads and ceiled with 2-inch planks, calked with one



LINES OF NORWEGIAN FISHING STEAMER MJOLNER.

thread of oakum, and pitched. Here are built up with loose boards the bins, for fish and ice. The capacity of this hold, of iced fish, is about 20 tons.

A fresh-water tank of about 350 gallons capacity is placed right below the galley under deck in the cross bunker. The fresh-water pump is in the galley.

MACHINERY.

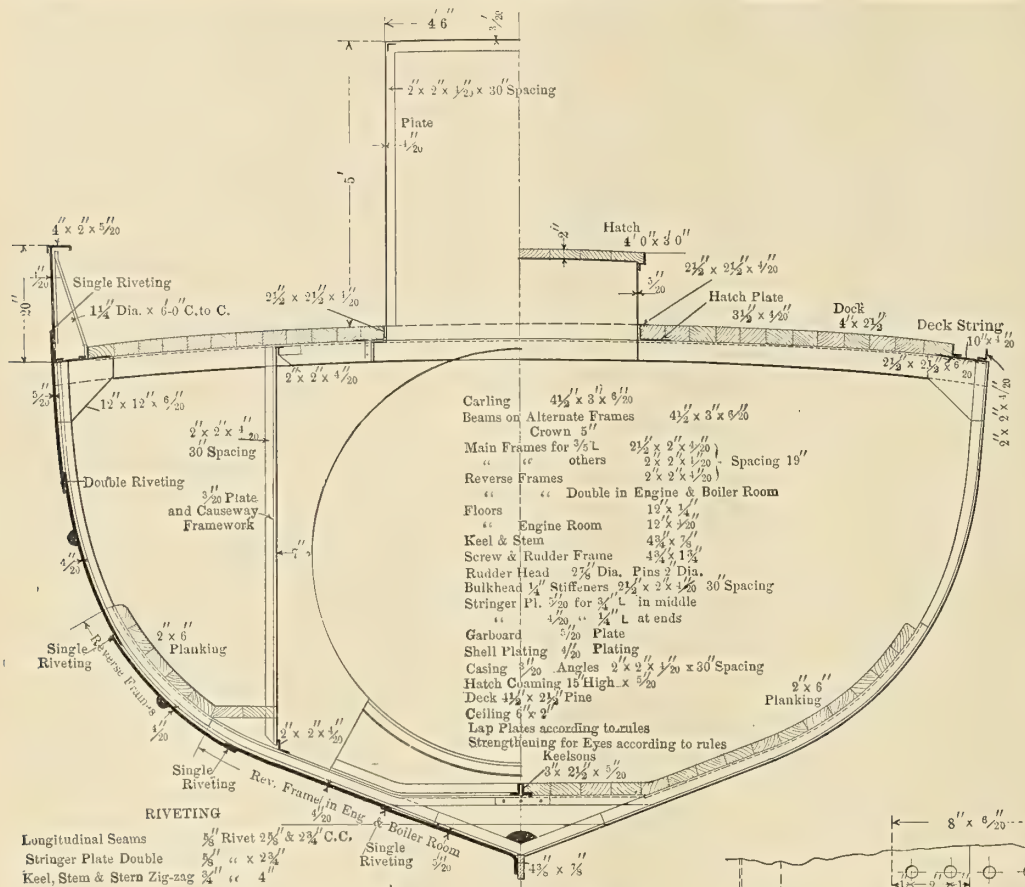
The propelling power of this vessel consists of a vertical, direct-acting, compound engine, data of which is given on the card. Marshall's valve gear works the valves; all pumps are worked from the low-pressure engine crosshead. All links and eccentrics, and arms for the valve gear, are of cast steel. Main bearings are babbitted.

All exhaust steam from auxiliaries is trapped to avoid waste of fresh water. The donkey pump is of the Worthington duplex pattern, cylinders 3 by 2 by 3 inches. It is used for feeding the boiler either from hot well, from condensed water tank, or from the sea cock. It also circulates the water in the boiler during earlier period of firing; it gives water to deck and fire hose and acts as a ballast pump. Besides the water fire hose there is arranged a steam fire hose which takes steam from the capstan steam pipe on deck.

The boiler is a horizontal, single-end Scotch boiler of sufficient capacity for easy steaming. Of interest may be noted that the boiler shell is of *solid rolled* steel

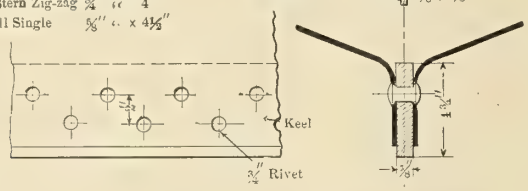
NAME—Mjölner. **NATIONALITY**—Norwegian. **TYPE**—Fishing steamer.
LAUNCHED—1903. **BUILDER**—Rosenbergs Mekaniske Verksted, Stavanger, Norway.

Length over all	75 ft. 0 ins.	**Engine**	compound
" over stem and stern	70 " 0 "	Cylinder diameter	8 ins. and 17 1-2 ins.
Beam molded at deck	15 " 9 1-2 "	Stroke	12 ins.
" " " W. L.	15 " 6 "	R. P. M.	155
Depth, top keel, top beam	8 " 9 "	I. H. P., estimated	80
Draft, aft	7 " 6 "	Speed	9 knots
" forward	5 " 9 "	Condenser surface	115 sq. ft.
Displacement	82 tons	**Boiler**	S. E.
Area of midship section	64.6 sq. ft.	Diameter	7 ft. 0 ins.
Block coeff	0.446	Length	6 " 6 "
Coal bunker capacity	14 tons	Furnace	33 "
Propeller	Friedenthal's corrugated	Pressure	140 lbs.
Diameter	4 ft. 6 ins.	H. S.	345 sq. ft.
Pitch	6 " 9 "	G. S.	12 " "
Number of blades	4	Draft	natural
Area of blades	11 sq. ft.	Coal consumption per I. H. P.	1.75 lbs.
Material	cast iron		

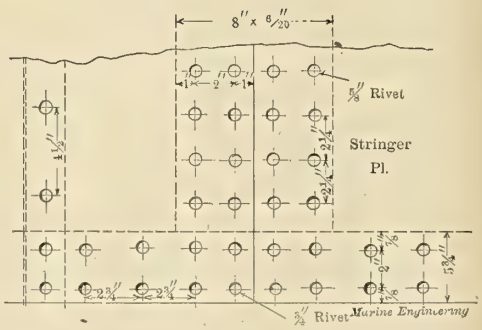

Carling 4½″ x 3″ x 6/20
Beams on Alternate Frames 4½″ x 3″ x 6/20
Crown 5″
Main Frames for 3/5 L 2½″ x 2″ x 3/20
" " others 2″ x 2″ x 1/20 Spacing 19″
Reverse Frames 2″ x 2″ x 1/20
" " Double in Engine & Boiler Room
Floors 12″ x ¼″
" Engine Room 12″ x 1/20
Keel & Stem 4¾″ x ⅞″
Screw & Rudder Frame 4¾″ x 1¾″
Rudder Head 2⅞″ Dia. Pins 2″ Dia.
Bulkhead ¼″ Stiffeners 2½″ x 2″ x 1/20 30″ Spacing
Stringer Pl. 5/20 for ¾″ L in middle
" 4/20 " ¼″ L at ends
Garboard 5/20 Plate
Shell Plating 4/20 Plating
Casing 5/20 Angles 2″ x 2″ x 1/20 x 30″ Spacing
Hatch Coaming 15″ High x 5/20
Deck 4½″ x 2½″ Pine
Ceiling 6″ x 2″
Lap Plates according to rules
Strengthening for Eyes according to rules
Keelsons
3″ x 2½″ x 5/20
Hatch 4′ 0″ x 3′ 0″
Hatch Plate 3½″ x 1/20
Deck 4″ x 2½″
Deck String 10″ x 1/20
Single Riveting
1¼″ Dia. x 6-0″ C. to C.
Double Riveting
3/20 Plate and Causeway Framework
Single Riveting
Rev. Frames
2″ x 6″ Planking
Single Riveting
Rev. Frames in Eng. & Boiler Room
Single Riveting
2″ x 6″ Planking
Plate 1/20
2″ x 2″ x 1/20 x 30″ Spacing
4″ x 2″ x 5/20
12″ x 12″ x 6/20
2″ x 2″ x 4/20
2″ x 2″ x 4½/20
2″ x 2″ x 1/20 30″ Spacing
4⅞″ x ⅞″

RIVETING

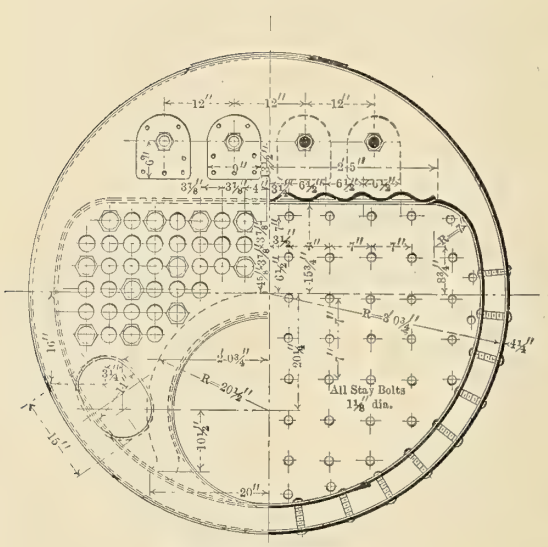
Longitudinal Seams	⅝″ Rivet 2⅝″ & 2¾″ C.C.
Stringer Plate Double	⅝″ " x 2¾″
Keel, Stem & Stern Zig-zag	¾″ " 4″
Frames to Shell Single	⅝″ " x 4½″

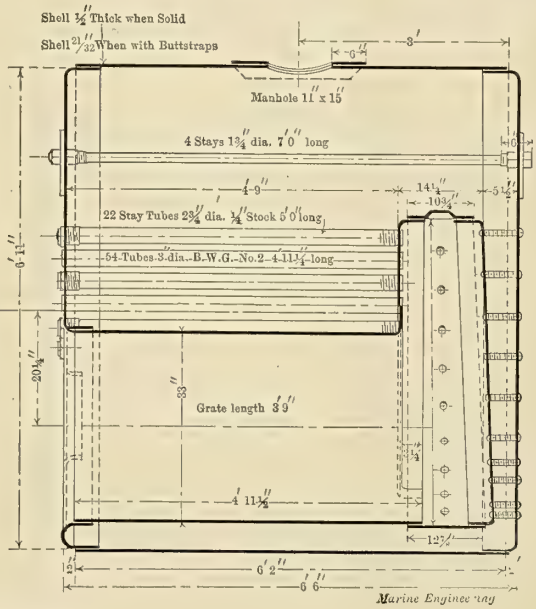


MIDSHIP SECTION.



Marine Engineering



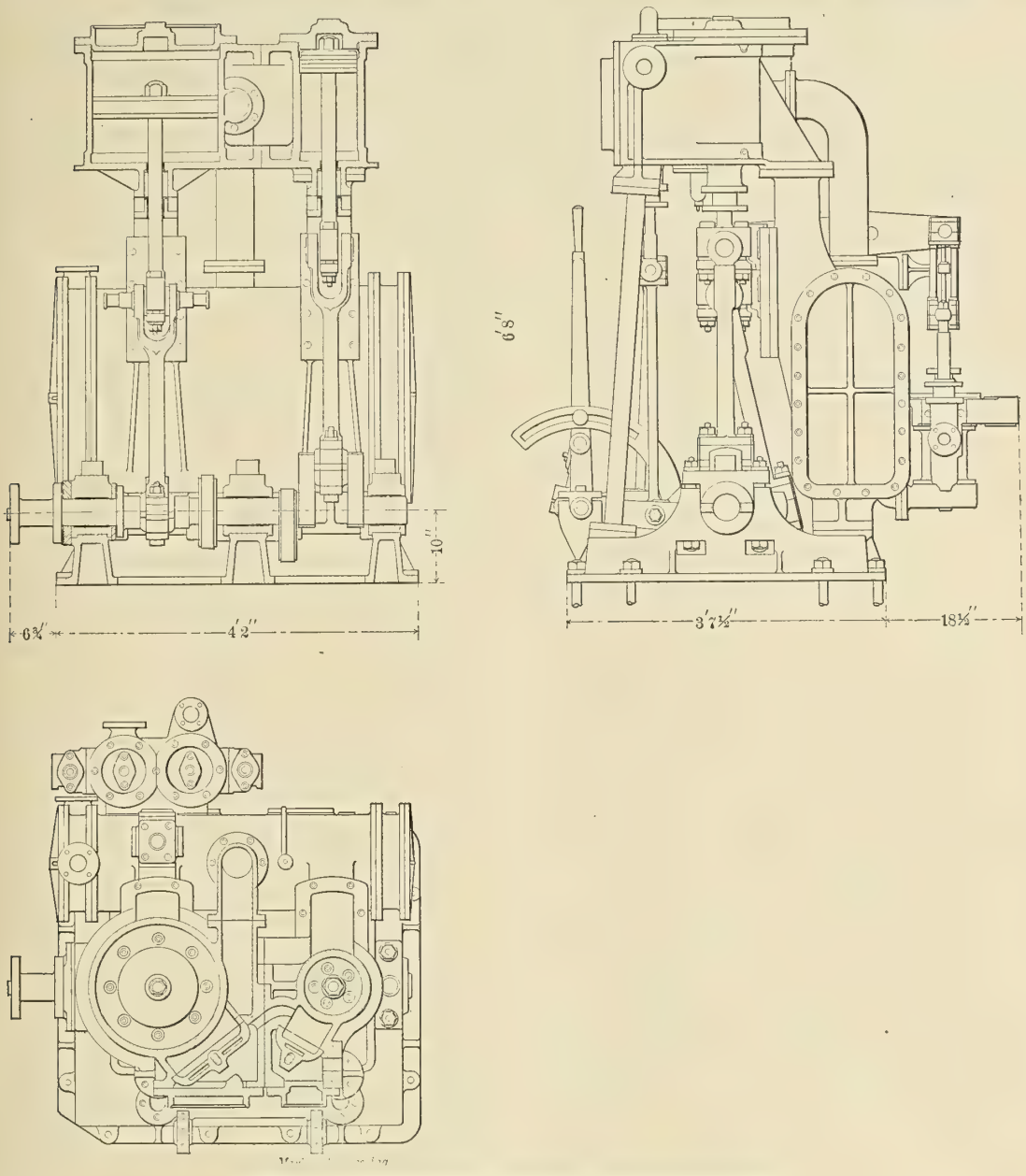

Shell ¼″ Thick when Solid
Shell 21/32″ When with Buttstraps
Manhole 11″ x 15″
4 Stays 1¾″ dia. 7′ 0″ long
22 Stay Tubes 2¾″ dia. ¼″ Stock 5′ 0″ long
54 Tubes 3″ dia. B.W.G. No. 2 4′ 11¼″ long
Grate length 3′ 9″

283 sq. ft. Tube heating surface.
62 " " Heating surface of other parts.
345 " " Total.
12 " " Grate surface.
140 lbs. working pressure.

BOILER, SINGLE PLATE SHELL,

NORWEGIAN FISHING STEAMER MJOLNER.

Marine Engineering



COMPOUND SURFACE-CONDENSER ENGINE FOR THE STEAMER MJOLNER.

plates without any longitudinal seam whatever. These shells are made by the Press und Walzwerk Actiengesellschaft, Düsseldorf, Reisholz, Germany, the only firm in the world that makes these solid rolled (not welded) shells up to 8-feet diameter. The process is the same as that of rolling a locomotive tire for driving wheels. By using such shells a reduction in thickness is allowed. The greatest gain, however, is the reduced risk of leaky rivet seams. The boiler furnace is ordinary plain welded, for corrugated furnaces are not in favor for small boats, as they are not so easy to clean.

All steam pipes to main engine and auxiliaries are taken from one solid cast-iron head, bolted with pin screws to a planed cast-steel saddle riveted to the shell. No steam dome or inside steam pipe is used, as experience shows that even in very boisterous weather no trouble arises.

The economy of this small machinery is surprisingly high—1.75 pounds of coal per I. H. P. per hour, not only on trial trips but in ordinary work. The trial speed of the boat is 9 knots, which generally answers to a sea speed of 8 1-4 knots. The price of the boat complete, fitted out for service, except fishing outfit, is about $9,000. The tonnage gross is 55.2 tons.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 62 vessels of 23,358 gross tons built in the United States and officially numbered during the month of December, 1903. The largest steel steam vessels included in these figures are: *Missouri,* 7,914 gross tons; *Père Marquette 20,* 5,409 gross tons; *F. B. Squire,* 4,582 gross tons. The totals for the three calendar years are, 1903, 1,159 vessels, 381,970 gross tons; 1902, 1,262 vessels, 429,327 gross tons; 1901, 1,322 vessels, 376,129 gross tons.

SHIPYARD ECONOMIES.—II.

BY R. S. HUBBARD.

ORGANIZATION.

1. *Preparation and transmission of plans, lists, and other information to superintendents, foremen, and workmen* is accomplished by means of various systems. The best system is that one which has fewest weak points, and the weaknesses are usually:

(*a*) Inaccuracy or incompleteness, etc., of plans.

(*b*) Tardiness in preparation.

(*c*) Failures to note alterations.

(*d*) Losing or mislaying plans, etc.

While *a*, *b*, and *c* are specially drawing-room weaknesses, *d* is a difficulty which will always arrive, with its contingent delays, wherever drawings are not received, kept, and issued systematically in the yard. Each foreman's office can easily be provided with numbered racks or drawers, and a book kept to record names and numbers of plans and names of persons to whom issued. If alterations are made on yard plans, dated duplicate notes should be issued to the superintendent and the foremen who are responsible for carrying them out.

2. *Working understanding with owners' representatives.* It often happens that a great deal of trouble and expense is caused by the want of a proper understanding between the builders and owners' representatives. In the absence of any precedents, their relations are apt to degenerate into "get as much as possible" on one side and "give as little as possible" on the other. The following suggestions are made to indicate the direction in which a proper understanding may lie:

(*a*) As far as possible all plans and information issued by the chief draughtsman should be presented to the owners' representative for approval and signature.

(*b*) When thus approved and signed, the builders should not be asked for any deviation from them without an extra order.

(*c*) Owners' representatives should give the builders ample notice of any special requirements, tests, or the like which they wish to carry out.

(*d*) A responsible member of the builders' staff should receive any requests or complaints made by owners' representatives, and attend to them, but no interference by the latter with foremen or employees should be permitted or attempted.

(*e*) Owners should supply builders with plans and specifications of a thoroughly complete and detailed description, in the first instance to supply a proper basis for the builders' estimate and afterward to avoid misunderstandings and mistakes during the process of construction. From the builder's point of view this is absolutely essential to conservative business, while owners will invariably profit from the fact that the builder can cut his safety margin in making his bid if he is sure of his ground. The Navy Department, profiting by its large experience with contractors, has been steadily improving its specifications and providing more detailed plans and guidance sketches, with the result of avoiding disputes and facilitating the progress of the work. Builders who are asked to tender for new construction upon insufficient plans and specifications may possibly cover themselves by notes accompanying their bids explaining the nature of the assumptions that they have been obliged to make upon points not fully described or referred to in the plans and specifications provided. If the drawing up of plans and specifications is left to the shipbuilder it is just as necessary for the same reasons that they be most complete and specific.

The difficulties experienced in building private yachts are notorious in this respect, as it is generally difficult to convince the owner that a quart cannot be compressed into his particular pint pot.

3. *Systematic preparation and storage of fitting-out details*, if properly attended to, will result in considerable savings. This attention usually comes from the superintendent's assistants or not at all. It is very common to find construction or completion of vessels being delayed by the fittings not being to hand, and it is rather rare to find material properly collected and stored ahead of the ship's requirements. It is sometimes objected that the interest is lost on money locked up by finishing material before it is required, but the money lost by delays is generally a more serious item, and sometimes fittings get lost if storage room is inadequate or system is faulty, but this reflects on the store department and not on the principle of early preparation.

Complete lists of fitting-out details should not only be prepared by the "chasers" from the specifications and general plans, but progress made from day to day should be recorded. From examination of the "chaser's" list, a superintendent should be able to discover whether the plan for any detail had been issued or not, and what had been done with forgings, patterns, or castings; what number of fittings had been completed, and how many stored ready for the ship. The storekeeper should keep account of numbers stored, numbers issued, and location of articles in store.

4. *Scope of operations of various departments.* At first sight it would seem that clear definitions as to "scope" would not be particularly desirable, on the grounds that it would be inconvenient to debar any department from taking in hand work which it could turn out, when, at the moment, it might be in a satisfactory position for handling it. Actual experience, however, goes to show that when a shipyard is running satisfactorily and at its fullest output, any indefiniteness in this matter will result in each department trying to shirk the doubtful piece of work without saying very much, but keeping a good excuse ready. Questions as to scope are often raised between shipwrights and joiners, plumbers and machinists, shop machinists and brass finishers, riggers and carpenters, and so on. The most satisfactory principle on which to make settlements is that of "use and wont," so that when once a department has undertaken work of a particular character it is held responsible for it until further orders.

5. *Efficient supervision.* While this subject has been touched upon in previous sections, it is of such vital importance that a few remarks on the work done by assistant superintendents, head foremen, and "chasers" will not be superfluous. There is often a good deal of talent and ambition to be found among these officials, but, apart from their jealousies, incompatibilities, and rivalries, the clashing of their authorities sometimes discounts their efficiency. Systems vary so much that remarks upon this point may only be of a general nature,

but it seems best that while head foremen must retain control of their own departments and be responsible for economical output and the efficient handling of their workmen, the superintendent's assistants should exercise certain powers in directing the course of the work, maintaining discipline and order, and obtaining and disseminating information.

The systematic working of a shipyard renders a large amount of listing-up work, records, and notifications in writing absolutely necessary, but it would seem that the best work can be turned out by a few really capable men rather than by a number of less competent ones. The latter naturally tend to become tied up in the red tape of an elaborate system, while the former can use a system as it should be used—as a weapon for the removal of difficulties and effecting economy of labor. While some hold the opinion that it is desirable to concentrate authority in a few first-rate minds capable of controlling many inferior ones, there seems to be one qualification. It is not safe to make any department of a shipyard dependent for its good working upon one mind alone, because absence, sickness, or other causes may then so easily impair that department's efficiency. In some large plants the necessary safeguard has been found in an "understudy" system. Each departmental head is provided with an assistant and successor who qualifies himself for undertaking his chief's responsibilities in case of his absence.

6. *Standardization and specialization.* It is difficult to over-emphasize the importance of standardization among the factors which tend toward shipyard economy, but up to the present it has seemed next to impossible for American shipbuilders to practice it. Small plants may be seen undertaking contracts which are in reality beyond their capacity and occupy them for years, while large plants build tugboats and car floats. It is possible that the realization of the fact that this state of things is injurious to all parties will cause a reaction in the future, and standardization in type will become recognised. Some shipyards in Britain have specialized on tramp steamers to such an extent that considerably lower prices are quoted to shipowners if they are willing to accept the standard design of the yard. Thus, while the shipowner can be quite sure of what will be supplied him by informing himself as to the performance of the previous vessel of the same type, the shipbuilder can figure upon a safe profit.

Firms doing warship and first-class mercantile work are in a similar position, although standardization is more a result of the regular practice of the government and the steamship owners than any achievement of the shipbuilder. Standardization and specialization are profitable not only from the fact that old drawings, patterns, and matrices, steel and lumber stock, etc., may be made use of again, but also because the staff and regular hands become accustomed to the class of work and can push it through with more promptitude and certainty.

Specialization has another aspect in its application to labor. As an example of this, it is easily realized that a shipwright who has been steadily laying decks and fastening chocks and fairleads on succeeding vessels will become more expert in this branch than his fellow-shipwright who has been laying keel blocks, shoring and fairing for some months. Thus it is always found economical to keep under foremen and their gangs moving from ship to ship doing a certain section of the work.

The work which has been done of late by the Bureau of Construction and Repair in standardizing such details as air ports, water-tight doors, valves, pipe sizes, and very many other fittings can scarcely be spoken of too highly; as apart from the many advantages which the system affords to the Navy Department itself, the savings which builders of war ships will gradually effect on succeeding ships will become more and more apparent.

ARRANGEMENT OF BUILDINGS AND YARD.

The limitations of human foresight are such that the general arrangement of a plant usually seems economically defective in some respects whether it is an old one or of the most recent design. Sometimes the defects are inherent in the site and geographical features, and sometimes in the arrangement or want of arrangement, but not infrequently they can gradually be overcome in the process of development or extension.

While special circumstances call for special treatment a few general principles may be considered. It is obvious that the fitters' shed must be close to the building slips, though it should not be so close as to hamper transport; and if there is any choice in the matter the longest ships should be nearest the shed, on the principle that the heaviest material should have the most convenient road to travel. The beam shed seems to call for the next preference in the matter of convenience for the building slips, and the angle and shape smithy ought to adjoin it. The steel yard comes next in order, its natural position being on the sides of the foregoing buildings farthest from the building slips. The fitting-out basin or wharf should never divide the building slips if it can be avoided, although it is a great advantage to have a few punches, shears, and fixed drilling machines within easy reach of it. It is also convenient to have wharves and access to both sides of the basin. The store department should be near both building slips and basin, and the car tracks should pass if not enter it.

The sawmill demands a position near the water and the road and must be reached by the car tracks. The wood yard should be next to it, and the joiners' shop and pattern shop should open on to the wood yard if possible. Yard machinists' shop, paint shop, and carpenters' shop should be placed near building slips and basin; coppersmiths, pipe fitters, plumbers and sheet-iron workers can be housed a little more remotely. Engine works and boiler shops need not be near the fitting-out basin if the car tracks are convenient, and offices of all kinds naturally come next the road. The mold loft comes best between the offices and the road. The smithy and forge, if arranged for the work of both departments, should occupy a central position.

Compactness of arrangement is essential, not only because it reduces distances for transport and actual land areas, but because it economizes the time and energies of the superintending staff and makes communication between the members more easy. A telephone system between the main offices and all departments of the yard is also a great convenience in this respect.

It is not by any means essential that the joiners' shop,

pattern shop, yard machinists' shop, riggers' loft, or mold loft should be on the ground level; in fact, on account of this consideration of compactness, it is generally an advantage to place them on a floor or in galleries above the ground; and in constructing new buildings it is a good general rule to build them of two or more stories even if the space above is not immediately required. Other departments which are better placed on the second floor are the store for electrical fittings, finished joiner-work store, pattern store, and plumbers' and pipe fitters' store. It is of course usual as well as desirable to have drawing rooms and photographing rooms upstairs.

In the construction of new buildings fire risks should be kept well in view, brick dividing walls or open spaces being necessary for cutting up the space into comparatively small units, but easy communication being preserved by fire-proof doors and the like. Most modern plants are now equipped with sprinkler systems and a private fire-pumping station piped to convenient hydrants. All these precautions have an economy in reducing fire insurance premiums even if no fires actually occur.

2. *Use of power-driven portable tools worked by cheap labor.* Although it does not by any means follow that because an equipment of portable pneumatic, electric, or hydraulic tools is being used for carrying out riveting, calking, etc., economy is being effected in these operations, yet the advantages may be very considerable under certain circumstances. The following table gives some results actually obtained in practice with hand and pneumatic riveting, although it is not claimed that results are invariably as satisfactory.

Gang A was a hand gang, consisting of 2 riveters, 1 holder-on, and 1 heater; Gang B used pneumatic riveter and consisted of 1 riveter, 1 holder-on, and 1 heater.

	Gang A.	Gang B.
Rivets put in per day; 3-4-inch diameter, straight work	396	388
Wages of heater per day	$1.84	$1.34
Wages of holder-on per day	3.00	2.34
Wages of each riveter per day	4.51	3.11
Wages of each gang per day	13.86	6.79
Price of labor, per rivet	.035	.0175
Pneumatic tool. Estimate of expenses chargeable to interest and depreciation on pneumatic plant, cost of driving power and attendance, wear and tear of service, air pipes, storage, repairs and attention to tool, per day	..	1.74
Same, per rivet	..	.0045
Total cost per rivet, ex. counting and testing	.035	.022

What losses there are are generally caused by the frequent leakages of air or water under pressure and by bad contacts and defective insulation in electric wiring. Loss due to undue resistance is sometimes caused by insufficient sectional area in the mains.

It is owing to the fact that pneumatic riveting can be satisfactorily carried out by cheap labor that it can sometimes be made profitable, as skilled men would not be satisfied with the wages they could earn at the lower rates paid. Unskilled men employed on calking and chipping are seldom able to keep their chisels, cutters, etc., in good order, and in any case a shop for "fettling" tools and keeping the hammers and drills in repair is a necessity. It may sometimes be combined with that required for other departments. Pneumatic power is, generally speaking, the most flexible and best adapted for the work on board the ships, although it has the disadvantages of occasionally freezing up in very cold weather and of costing a good deal for hose and repairs; at the same time electricity is very satisfactory as a motive power for all kinds of drilling, and tools driven by electric motors are almost necessary for boring out, facing up, cutting circular holes of large diameter, etc. Hydraulic manhole punches, shape cutters, flangers, and frame riveters seem to be still the best tools for their particular purposes.

3. *Power station economies.* In small plants it is generally customary and economical to concentrate the power generators in one station near the fitters' shed, but where the area is large and power distribution takes place at a long distance from the point of generation some subdivision is advantageous. In one large plant the fitters' shed, joiners' shop, smithy, and hydraulic plant were grouped together for the power supply, while the machinists' shed, saw mill, electric-lighting plant, heavy cranes, etc., were driven by a second station. As the distance between the steam hammers in the smithy and the saw-mill engine was more than a quarter of a mile, the reason for duplication is obvious. In some plants, on the other hand, small boilers and engines are to be found scattered in all directions, and the losses from the multiplication of engineers, transportation of fuel, etc., more than counterbalance the gains from reduction of distances.

Without entering into any arguments upon the relative merits of automatic stokers and hand firing, water-tube boilers and forced draft against fire-tubes and high chimneys, independent motors instead of long lines of shafting, and the like, it may be suggested that a few tests are sometimes very instructive. Indicator cards should occasionally be taken from an engine driving shafting when the tools are not being used, the resistance of the leads to independent motors may be tested from time to time, power station fuel consumption may be checked, and also fuel consumption for forge and fitters' shed furnaces.

Where hydraulic lifting appliances are used the power drawn from the pumping engine is usually the same for each operation of the ram, whether 3 tons or 300 pounds are being lifted. As it is not convenient to enforce rules which would keep the crane or derrick waiting for a full load these appliances, though useful, are often wasteful.

If one boiler is fitted with a furnace designed to burn sawdust, shavings, chips, and other refuse more expensive fuel is saved, and the arrangement is convenient as a rubbish destructor.

4. *Transportation.* Economies derived from the use of cheap labor for transportation service have already been remarked upon, but other possibilities exist in connection with the reduction of the amount of transportation and the mechanical means employed. Under ideally perfect conditions steel, lumber, and other material entering the yard would be unloaded so that it could be selected and transferred to the machines without hand labor, and, when prepared, removed to its position in the ship by mechanical means; but it generally happens that such perfection would only be attained by a

too great outlay on plant. A small outlay, however, will pay for means of stacking plates on edge for convenience of selection. Smooth roads may be preserved and kept clear for moving the steel, etc., on hand barrows if narrow-gauge rails and bogies are not among the resources of the plant. A steel wire span with a traveler and winch will prove a fairly good substitute for an overhead crane for small and moderate-sized vessels, and means can generally be arranged for stacking lumber close to the car lines and yet convenient for the saws or deck planer.

Transportation of armor plates is a consideration of a special kind and must be governed to a great extent by the features peculiar to the plant. If delivery can be obtained in time it is generally advantageous to fit at least the lowest tier of plates in the ship before the launch, even although the extra weight of the vessel may somewhat increase the expense and risk of the launching operations. Although in some plants it may be possible to lift the plates to their berths without floating them, the work is not so conveniently done from floating stages, and the necessity of fitting both sides of the ship simultaneously to avoid a heavy list is often a drawback. Installing the engines and boilers has also sometimes to be delayed to prevent the vessel sinking to a water line above the level of the armor shelf.

The advantage of having car tracks beside the building slips comes out strongly in this connection, as the plates can then be laid out for making molds for trimming sheathing in positions quite near the plate berths.

5. *Arrangement of power-driven fixed tools.* Although it would be inappropriate to discuss such arrangements as would involve radical alterations to an existing plant, the fact that new tools are often added to and old tools moved in plants already established, suggests the comment that all such changes should be made in accordance with a scheme which takes account of possible improvements to the existing facilities and of the nature of the work which is likely to be undertaken in the future.

The steel work of small vessels is sometimes let to piece fitters in a lump contract covering the whole of the work, while that of large vessels requires to be more or less subdivided among several large gangs. In either case that arrangement of the tools is most advantageous which admits of the large jobs like framing and bulkheads, shell plating, deck plating, and casings being carried out with a minimum of transportation from one fixed tool to another, and without causing the work of any one gang to be delayed by waiting for the use of a tool which is being operated by another gang. Time and labor will therefore be economized if the framing plant, including shape cutter, vertical and horizontal punches, furnace and angle beveller, manhole punch and floor shears are arranged in a convenient bay or line; the plating plant, including plate furnace and accessories, combined punch and shears, flanger, mangle, rolls, countersinker, scarphers, planers, etc., in a second bay; while the plain plating and jobbing departments have a third outfit of tools.

In the joiners' shop something of the sort can also be done by arranging saws, planers, face and edge machines, mortise and tenon machines, dovetailers, spindle cutters, and molding running machines in a consecutive order, so that the wood may be handed direct from one machine to another without being carried over the same ground twice.

In shipyard machinist shops the work is so varied that no probable order of operations can easily be mapped out, and the best practice seems to be simply to place like machines with like—lathes together, planes together, and so on—with a fast overhead crane to move the material about.

6. *Upkeep and new construction.* The economy of good upkeep is generally most appreciated when a breakdown has occurred during a special rush and the repair gang is working night and day to get into running shape again. An annual or half-yearly holiday shut down of a few days gives an excellent opportunity for blowing-down, inspecting scaling, and repairing boilers, opening up the main engines, inspecting and repairing furnaces, and so on, besides having other advantages. Although the practice is by no means general some firms employ a plant superintendent or master of works who is responsible for all repairs and new construction, and incidentally for any delay resulting from failure to keep running. Nothing is lost by keeping spare parts of engines, shop shafting, and, in fact, spares for all working parts which have a special habit of breaking down. Upkeep of standing plant, such as buildings, tracks, water front, power mains, etc., can usually be attended to "piecemeal" during the ordinary running hours; repairs which involve delays can be prepared for but carried out when general work is suspended. The master of works will be able to undertake most of the new construction in an established plant, and it is generally accepted that buildings, etc., should be substantial enough to stand for 20 years.

7. *Shop economies.* It is a general principle that work which can be carried out in the shops (with their advantages of machine tools, good benches, and greater comfort for the men) should not be done on board the ships; but the principle should be pushed even further with safety—work which can be done by outside subcontractors at a less price, made possible by specialized tools or organization, should not be done in the shops. This latter consideration applies very frequently in the case of air ports, certain makes of water-tight doors and their gears, valves for plumbing and pipe fitting, lifeboats and rafts, heavy davits, and many other fittings which would generally be undertaken by the shipbuilder if his plant were sufficiently specialized. There are, however, some few economies in connection with certain of the shops which deserve mention.

a. Joiner Shop. The men should not require or be permitted to leave the shop in the ordinary course of work, nor to hang about the machines unless their presence is required by the machine man who is preparing the material they are to work. As a general rule, however, they should only need to mark the wood for machining, leaving it beside the machine and removing it when finished with.

As in all cases, the peculiar abilities of the men should be looked out for and developed. Some are specially good at heavy work like skylights, companionways, and deck houses; others excel in turning out a long order of plain work like panelling or doors;

others, again, are at their best on fine work like hardwood furniture which is to be polished.

The joiner shop has been referred to before as a good field for the introduction of piecework or premium system; although rare in shipyards, piecework is frequently adopted in car works, house building, etc. In drawing out the details care should be taken to avoid curved work as much as possible, as the curves involve waste of material. Inferior qualities or cheaper kinds of lumber should always be ordered for backs and interior fittings, and as special prices have to be paid for extra widths, etc., in cut lumber, dimensions of parts require to be kept down. Although not at present adopted in all shipyards the sand-papering machine and hand-worked tools for miter cutting save a great deal of time and labor.

Chairs, tables, mirrors, and other fittings generally used in houses can often be bought outside more cheaply than they can be made in a shipyard joiner shop.

b. Carpenters' Shop. Although it is often thought that shipwrights do not require a shop to work in there are certain jobs which are much better done under cover, even if the "shop" is only an extension of the spar shed. The carpenter shop should have racks for the stowage of tool chests, a circular saw, and perhaps a planer, a plug-cutting machine, an auger-drilling machine, and a grindstone, and the foreman's office should be at the end of it. In this shop bolted hatches, etc., can be made, wedges and slivers cut and stored, molds made, boat's chocks prepared, and many odd jobs conveniently taken in hand.

c. Yard Machinists' Shop. In a good many plants no shop is exclusively devoted to yard machinists' work, the engine works being supposed to undertake all machining and vise work for the yard, charging time and material to shipyard account. Even in small plants, however, this plan seldom works well, and in large plants it is generally pernicious. Water-tight doors and their fittings, hinges and dogs for non-water-tight doors, and all kinds of smith finishing work, fittings for gun-port doors, gangway doors, hatches and steel skylights, drilling and countersinking of holes, and many other detail jobs for hull work do not call for great accuracy in the matter of finish. The workmen require to be trained to turn out jobs with rapidity rather than with great refinement and to know the special requirements of hull work, while a lighter class of tools is better adapted for doing hull jobs. It is natural for the engine-works foremen to regard the hull details as a secondary matter, and the charges for labor are generally found to be excessive. A yard machinist department with an independent shop avoids division of authority and is really an economy in spite of the duplication which would at first sight appear to be disadvantageous.

d. Blacksmith Shop. Smith work can be and often is done by piecework and the system is quite satisfactory, but the greatest source of economy at the present time is the introduction of the drop hammer and standard dies and automatic bolt machines. While it is possible to do a good deal of die work under a light steam hammer, large numbers of similar details and fittings for hull work can most conveniently be done under the drop hammer by piecework and at very cheap rates. The initial cost of the dies is covered in a very short time, generally in the first fifty of an order. An automatic bolt machine, once introduced, will be found at work continuously. In designing blacksmith details, however, expense can often be saved by making use of steel castings where it used to be customary to put in wrought-iron fittings. Female portions of hinges, sockets of various kinds, stowing and lashing eyes and pads, parts of turnbuckles, brackets, etc., are now in many cases made of steel when the number is sufficient to pay for the pattern making.

e. Pattern Shop. A good foreman pattern maker will effect marked economies by attention to two or three points. While good material and good finish is required for many of the smaller patterns a number of the large patterns, being used only a few times by the molder, can quite well be made of very rough material and finished roughly. It is possible to save a great deal also by making skeleton patterns wherever they will serve the purpose, especially for pipe bends and sea connections, bushings, and the like. As a great many patterns are of no further use after being used for their special purpose it is a good plan to have them conveniently stored so that they may easily be looked out and altered according to requirements when something near their shape is called for.

MATERIALS.

1. *Orders and deliveries.* So much of the success of shipbuilding depends upon the prompt and well-timed delivery of material that the efficient working of the purchasing agent's department possesses great importance. The secret of satisfactory delivery depends in a great measure upon the requisitions being made in good time, but also upon the judicious placing of the order. It is not an unusual thing to find that some item requiring early order has been overlooked until the vessel is nearing completion or has been shelved for want of information. It is easy, however, to prepare a key schedule or index from the original plans and specifications, placing the name of the department responsible for the requisition and the probable date required opposite each item. If this schedule is kept annotated by the purchasing agent an occasional inspection of it will prevent surprises. In asking quotations the date when delivery is required should of course be stated on the inquiry, and if subcontractors overrun their time correspondence should commence at once.

2. *Store department organization.* Labor can be saved within this department itself by good arrangements and convenient weighing and lifting apparatus, but the greatest economies result from an organization which keeps perfect account of stock and produces it promptly on demand. The numbers and locations of all articles of outfit, equipment, etc., can be very easily kept account of by means of a suitable card file; bolts, rivets, screws, and nails, oakum, tallow, and the like, are better kept by receipt and issue books.

Foremen should be immediately notified of the arrival of special materials or articles ordered for their departments, and the purchasing department should arrange that all material is properly marked with the number of the hull for which it is required, by the firm supplying it, for purposes of identification.

Although as a general rule very little material should be carried as general stock, certain sizes of bolts and nuts, screws of standard thread, rubber, and some other articles are so frequently called for that a few exceptions may be made, and weekly replace requisitions from the store department take the place of the usual drawing-room requisitions. This method prevents the delay which sometimes occurs when very small orders are placed outside. No material should be issued under any circumstances to workmen who have not presented a properly filled in "line" from their foreman.

3. *Saw mill and wood yard organization.* Although a log-cutting saw mill in a shipyard is a great convenience when special sizes of cut lumber are required on short order, it seldom shows any book advantage. Monthly accounts generally show that the lumber merchant can supply the cut stuff quite as cheaply as the shipyard mill, and make his own profit besides, and very little reflection will make the reason clear. If, however, as sometimes happens, a saw mill doing a general business is run beside and in conjunction with a shipbuilding plant, the latter reaps an advantage without detriment to the former. The whole of a cheap lot of logs can then be bought instead of the net quantity for shipyard requirements, and the mill is not so likely to be frequently running at reduced output. In order to cut logs profitably they must generally be cut *for what is in them,* while the mill run for shipbuilding purposes exclusively requires to cut the logs to obtain certain sizes of lumber.

The wood yard is best divided into two departments, in one of which lumber is stacked for joiners and pattern makers, principally under cover, while the other deals with the material required for shipwrights and general yard purposes. Workmen should not be sent to the wood yard to select and cut out their own pieces, but orders should be handed in to the wood-yard clerk by the various foremen, the wood-yard staff breaking out the stuff and delivering it as required. The necessity for this arises from the fact that a workman will always pick out the best and cleanest piece of material he can find for his purpose, without much if any regard to what he leaves or the quality of timber his job really requires.

4. *Steel and iron-yard organization.* While a great deal of time is often wasted by bad stacking and insufficient means for handling plates and shapes, the fact that steel and iron is usually ordered from the steelmakers to scheduled sizes prevents or should prevent much waste of the material. It is always necessary to keep a certain amount of stock, however, and it is in the careful management of this that economies can often be secured. Small quantities of material are generally left over after the completion of a hull, and these leavings will accumulate and rust into uselessness unless properly looked after. A stock book should be kept by the iron measurer and daily account taken of all receipts and issues. A corresponding book should be kept in the drawing room, daily changes viséd and signed for by the chief draftsman, and new orders of material for stock checked by comparison with the sizes at present on hand. An alteration will often throw a batch of material into the stock book for an unavoidable reason, but unless the sizes or sections are very unusual, a use will very soon be found for them if not overlooked. Here, as in the store department, all issues of material should be made by foreman's order sheet and cuttings returned.

In conclusion it may be remarked that shipbuilding being an industry full of the most multifarious detail, economy is the result of attention to the small things rather than to the broad generalizations of design and organization. If work were always done correctly at the first attempt, if nothing were ever forgotten, and if cost accounts were always completely rendered, shipbuilding could be made to pay without regard to "trash about details"; but human nature being as it is, the patient and laborious qualities succeed in shipbuilding where superficial brilliance ignominiously fails.

Construction of Line Shafting.

BY H. E. RAABE.

The number of breakdowns of marine shafting and the repairs thereto are the subject of almost continuous discussions in the technical journals, and yet there is practically no deviation from the old rules and formulae, and new ships are coming out with shafts built on the same lines as those years ago. The shafts of large steamships continue to break, and there appears to have been little effort made to rectify this most annoying breakdown.

Spring couplings for small shafts have been devised, which have proved satisfactory, but no spring coupling has ever been applied to a heavy shaft with any degree of success.

The breaking of a line shaft of a steamship is actually not the worst breakdown that can happen at sea, providing the engine is slowed down before it has time to race itself to pieces, which the wideawake engineer on watch always manages to prevent, and providing the shaft breaks "where we want it to." No engineer, however, wishes his shaft to break, no matter in what place, no more than a motorman of a trolley car wishes his armature winding, etc., to burn out. Designers of trolley cars, however, know that this is unavoidable, no matter what the conditions may be; on an even grade, with probably an empty car and perfectly dry weather, all of a sudden "a fuse blows;" well, that is what the fuse is there for; if the fuse were not there, probably the whole armature winding would burn out, or receive a puncture somewhere sufficient to put the car out of commission. With the fuse, however, the motorman makes the necessary repair on the spot and in a few seconds.

Now this great convenience to repair a trolley car exists regardless of the fact that there are plenty of "cars ahead" and "cars behind." A steamship, however, is sent out to sea without any convenient method of repair, except a few tools and a few spare parts, which sometimes do not fit, as described in MARINE ENGINEERING of November, 1903, in the account of the breakdown on board the German steamship *Syracusa,* where the holes in the coupling of the spare shaft did not correspond with the holes in the coupling of the section which was in service.

While the writer does not intend to urge designers of steam vessels to put a safety plug into a shaft, yet, since the shafts have the habit of breaking, in most cases

either inside of a bearing or close to a coupling, he would like to offer a few suggestions that may be of some value to some one interested in this subject.

A method often employed to construct line shafting for a steam vessel is shown in Fig. 1. This form is very frequently employed in small and medium-sized shafting; the writer has also found it on large sizes up to 20 inches in diameter. The shaft is turned off and finished only at the ends, where the couplings are to be shrunk on, and also in places where the bearings happen to come. The rest of the shaft is left rough. It would be a waste of time to turn the shaft from end to end, and, besides, the rough surface is much easier to paint than the finished surface would be.

This is a good and common-sense argument on the part of the builder, who figures on the cost; however, the operating engineer at sea, after reading this article, will naturally think quite differently. One day the writer called on a marine engine builder who has a high reputation for his good workmanship; one of the men in the shop was just finishing the ends of an 8-inch line shaft previous to fitting the couplings. The shaft was 8 inches in diameter in the rough, and 7 13-16 inches at the finished ends; and as the shaft called for should have only been 7 3-4 inches, the owner of the shop thought he was giving his customer a very liberal allowance for his money. Upon being asked if he did not consider this form of shafting rather faulty, he promptly replied, "No; if you turn the shaft from end to end, you lose the best of the stock, which is near the surface of the shaft, at the same time you decrease the diameter of the shaft, so you naturally must see that this is the stronger shaft." Well, this certainly is true, outside of the bearings and the couplings, but is it possible to make a shaft any stronger than its weakest point? The weakest point naturally will be at the ends of the coupling hubs, where, besides the reduction in diameter, the cross section is reduced by a few good effective square inches on account of the keyway.

If such a shaft should break, it will almost invariably break inside of a bearing, or close to a coupling, where it will be very difficult to make the necessary repair.

In Fig. 2 is shown a somewhat better construction of shafting; in this case the ends, which are turned to receive the couplings, are upset, thus the section is increased; the same should also be done with the journals.

Wherever this form is used, the tendency is always to make the upset ends too short, and to make the increase in diameter too abrupt; thus the shaft has an even chance to break at either *A* or *B*, Fig. 3; in fact, the tendency is to break at *A*, just where the sudden increase in diameter occurs. The reason for this is, that, due to the strains caused by unequal expansion when the forging is being cooled, the weakest part of the shaft is at *A*. In a case like this, the break is just as bad as it would be in a shaft of the kind shown in Fig. 1. The amount of shaft projecting beyond the coupling or bearing is not sufficient to properly attach any device for emergency repair, and thus repairing will be very difficult and unsatisfactory.

An improvement on the foregoing design is shown in Fig. 6; here the upset ends are continued beyond the coupling for a considerable distance, and instead of being reduced abruptly, the diameter changes gradually, thus lessening the danger of shrinkage flaws. For good practice, the parallel part of the large diameter should be carried beyond the coupling and each end of a bearing an amount equal to the diameter of the shaft, and the tapering part should be at least as long as the radius of the shaft. It will plainly be seen from the figure that the weakest part of the shaft, in this case, is

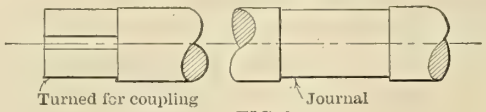


FIG. 1

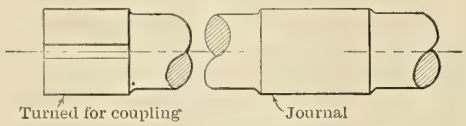


FIG. 2

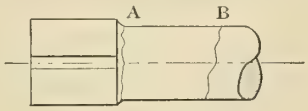


FIG. 3

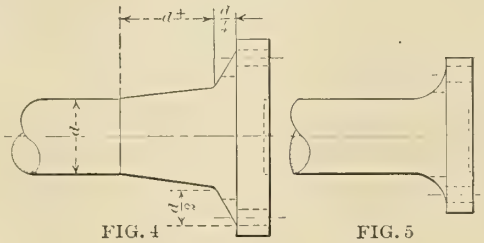


FIG. 4 FIG. 5

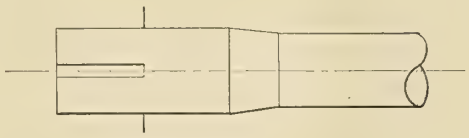


FIG. 6

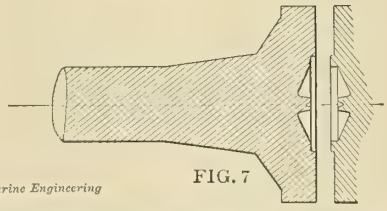


FIG. 7

very easy of access, and the chances of repairing a break are far better than in the former cases.

The custom to-day is to forge the shaft and coupling in one piece, which is very good practice, as the diameter of the couplings is reduced considerably, decreasing their weight; besides this, there are many other advantages, upon which we cannot dwell in this article. The tendency, however, is to make the coupling flanges too thin, with regard to the diameter of the shaft, at the same time also making the junction between shaft and flange too abrupt; both of these mistakes will cause a weak spot in the shaft, where repair work is very difficult.

An improved form for this kind of a coupling is shown in Fig. 4; here the flange is made with a larger diameter than is customary, in order to obtain the proper width for the bolt heads and nuts. Instead of the usual circular fillet at the junction, the diameter of the shaft is first gradually increased toward the coupling for a length at least equal to the diameter of the shaft. This taper is met by a libral fillet, which runs into a conical outline, and finally meets the parallel part with an easy curve. The flange in this case is made much heavier than usually. The writer has seen shafts, with solid couplings, of a design shown in Fig. 5, where the radius of the fillet was almost as long as the width of the flange, and the bolt heads and nuts were set into recesses, countersunk into the fillets. The designer of such a shaft evidently bore in mind the strains due to unequal expansion, and tried to overcome the abrupt junction by a large fillet. In this design, however, a large bulk of metal is placed at a point where the metal should be reduced, and that gradually.

In Fig. 7 is shown a longitudinal section for a solid cast-steel shaft, with solid couplings. Here the same outline is used as in Fig. 4, except that it is still more pronounced; the center of the coupling, however, is taken out for a considerable distance, in order to make the change from one shape into the other still more gradual, which is very important for cast steel. In order to avoid the use of a false center in turning such a shaft, it is advisable to allow a boss to project as shown.

The journals for these shafts, as well as those forged with solid couplings, should be constructed as those for the shaft in Fig. 6.

Fishermen's Way of Raising a Boat.

In comparison with the elaborate outfit of a ship wrecking company, I was struck with the simple but effective means adopted by the boatmen of the Penobscot bay region to raise a fishing boat off Swan's island, near Mt. Desert, Maine, during the summer of 1903. No appliances, except their own primative methods and native common sense, were used in the undertaking.

The boat was an ordinary fishing boat, sloop rigged, with about two tons of pig iron ballast on board. She was overturned in a heavy gale and sunk in about 60 fathoms of water and in a channel where the tide runs free and strong. The securing of a diver and his outfit from the city would be an expensive undertaking, especially as finding the vessel was an uncertainty. The

RAISING A SUNKEN FISHING BOAT OFF THE COAST OF MAINE.

method adopted by the fishermen was as follows: Two ordinary fishing boats, the same type as the one which was lost, started sailing down the channel about 200 feet apart. Between them was stretched a heavy cod line heavily weighted so that it dragged on the bottom. The vessels sailed along parallel to each other backward and forward until the obstruction was found. From the fishermen's experience they seemed to know whether the obstruction below was the boat they were after or not. In this case it was the boat.

A life line was then used to carry below a one-inch rope, which was weighted and carried round and round the sunken vessel by one of the boats sailing in a circle. In this case the fishermen succeeded in getting the line around both bow and stern and around the mast as well. Two larger fishing vessels were then brought up abreast to each other about a dozen feet apart, as will be seen in the picture, and a stout spar or timber was placed

across their decks. The two ends of the rope were attached to this spar, which was slowly turned over by hand power, winding the rope around it until the mast of the sunken boat appeared above water. The mast was pulled from its socket, but the shrouds and rigging held it fast until the bow appeared above the surface. Then additional lines were made fast around the bow and the vessel was supported almost vertically.

An anchor from one of the boats was now carried inshore by a small boat, the full length of the cable, and by heaving on the cable all three vessels were worked inshore. The anchor was then raised and carried inshore again, and the operation repeated until finally the vessels were brought at high tide to a shallow spot off shore, when in the receding tide all three were beached. On the next tide the two sound boats were, of course, warped out, while the sunken one was warped in on the beach, and found to be scarcely damaged; even the compass, which lay on a seat near the steering wheel, was intact. There were only a few scratches along the keel and a slight dent in the rudder. The ballast, of course, shifted more or less, but nothing was damaged, not even the rigging, except a tear in the mainsail, and the mast displaced, as above mentioned.

Although this method of raising a boat is quite common in this region, it is seldom successful because of the difficulty in finding the sunken vessel, or when found, to get a strong enough hold on her to allow of raising her, weighted down as she is with ballast, etc. In this case the operation took 26 hours of continuous work, during which time none of the boatmen left their positions.

Six Months' Shipbuilding Returns.—The Bureau of Navigation reports 571 sail and steam vessels of 177,067 gross tons built in the United States and officially numbered during the six months ended December 31, 1903. During the corresponding six months ended December 31, 1902, 627 sail and steam vessels of 171,599 gross tons were built in the United States and officially numbered.

Notes on Shipbuilding Facilities of San Francisco.

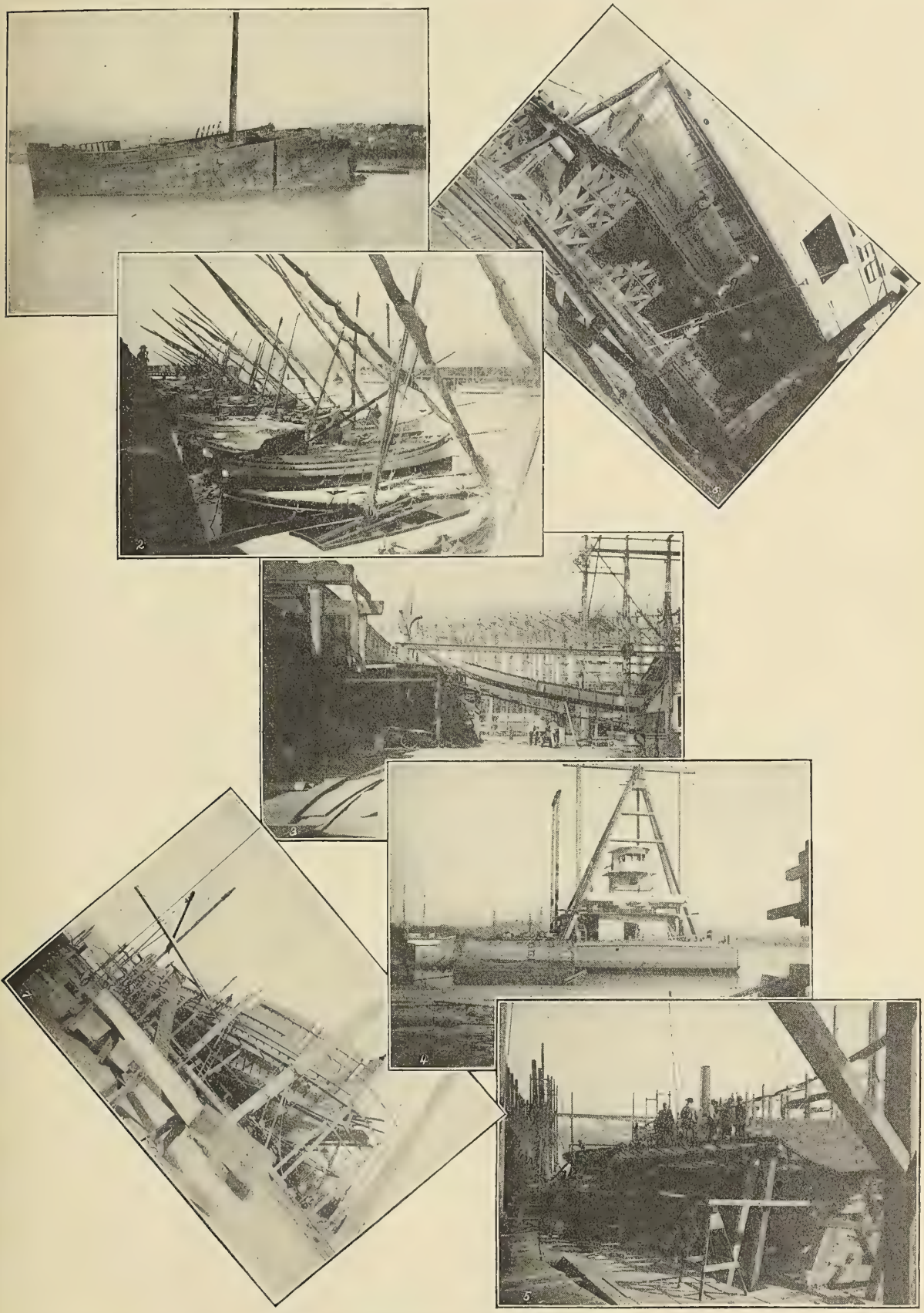
BY H. H. BAILEY.

There are in all five shipyards in and about San Francisco which are equipped for building large steel vessels and for carrying on a large amount of repair work. Three of them are located on the San Francisco side of the bay, while the other two are on the Oakland or eastern side of the bay. Up to very recently all the yards on the coast have been severely handicapped, due to the great distance separating them from the coal mines and steel mills of the East, but since oil has come generally into use as a fuel, the yards are now using liquid fuel in boilers and furnaces, thus solving the fuel problem. The fact, however, that all the steel must be brought from mills in Pennsylvania, which generally takes from five to six weeks, still remains a serious handicap.

Most of the vessels for the Pacific harbor, coast, and ocean service, flying the American flag, have been built in these yards. Two of the yards also carry on a large business outside of shipbuilding. The port is well provided with dry-docking facilities, as there is one company which operates six marine railways, and other companies which operate three large dry-docks, three floating dry-docks, a marine railway at Alameda, and a large railway at Oakland. At the present time work on the coast is rather slow and there are no immediate prospects for new contracts.

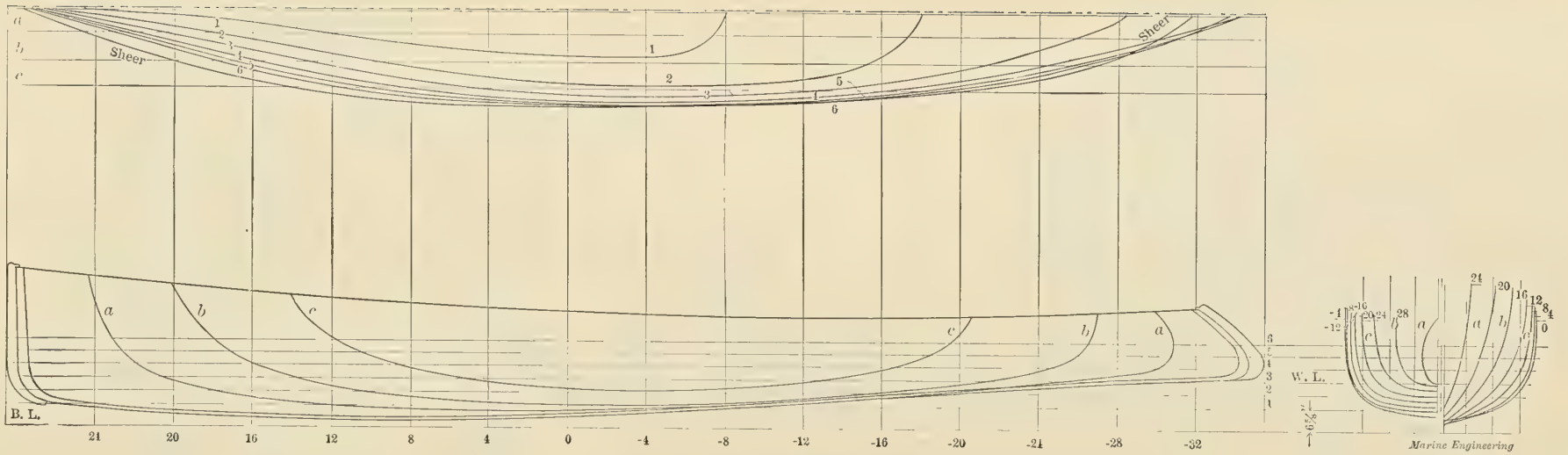
BARK GIFFORD, WRECKED NEAR GOLDEN GATE, SAN FRANCISCO.

For wooden construction there are a number of firms building boats here on the bay. However, small boat building, especially that of yachts, is almost in its infancy. San Francisco bay makes an admirable cruising place for yachts, as it is a large inland body of water and there is generally a good breeze blowing the year round—the trade winds. The climate is such that it is not necessary to lay a boat up in the winter months, which should surely be an inducement to yachtsmen. There are in all eight small wooden boat builders on the San Francisco side of the bay, six across at Oakland, two at Sausilito, and one at Tiburon. All of these build



VIEWS ALONG THE WATER FRONT OF SAN FRANCISCO HARBOR.

1. Wreck of Steamer *Progresso*.
2. Landing for Italian fishermen.
3. Unfinished bow of cruiser *Milwaukee*.
4. Product of United States Dredging Company.
5. Working on steel vessel at the United Engineers' Works for the Alaska Packing Company.
6. Fitting new outer bottom forward on passenger steamer *Monticello*, Hay and Wright's shipyard.
7. Wooden steam schooner under construction at Frank Story's yard.



LINES OF 32-FOOT SPEED LAUNCH EUSONIA.

small boats of every description and carry on general repair business. One of the builders is an Italian, who terms himself the "Oceanic Boat Builder," and caters almost entirely to the Italian fishermen, of whom there are a great number on the bay.

It is a very beautiful sight, indeed, to see a fleet of these fishing boats coming in through the Golden Gate, their sails tanned a dark reddish-brown, and, in fact, the boat and rig being that of a typical Italian fisherman. The meeting place at the landing is one of the sights of the city. It is interesting to note that these Italians are of late finding out that a fishing boat equipped with a gasoline engine has a great advantage over the sail-propelled craft, as much time may be saved with it in handling nets and catches. The Italian is not slow in adopting this new form of propulsion, and soon we may expect his picturesque sail boat to become a thing of the past. Gas engines are being quite generally used in other than fishing boats, and the three makes made on this coast are very generally used.

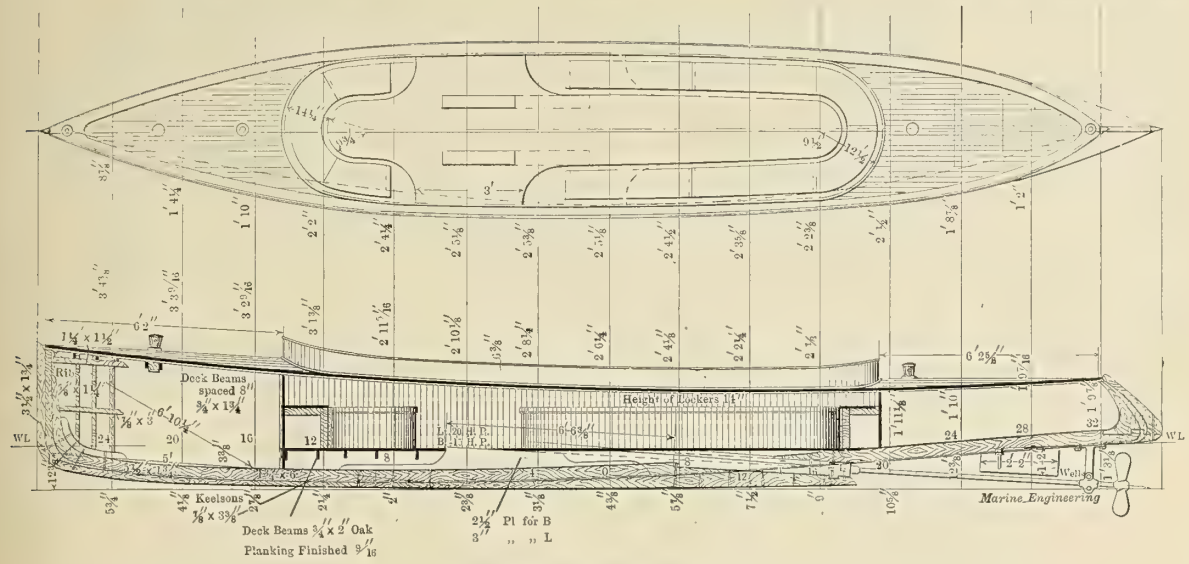
While the wooden boat builders have a little work on hand they all report work as being dull. There are five yacht clubs in and about San Francisco, one at San José, and one at Vallejo. These make up the list of yacht clubs in the state, and by going over the boats registered in them one finds that they are not of a size or class sufficient to furnish much new work for a boat builder. A large dredging company has of late started in to build its own dredges and barges.

As a whole the facilities here for handling any class of ship work are very good, with the notable exception that there is no first-class wrecking company. There would be much work for such a concern on this long and rocky coast, and many a ship might be ultimately saved if a well-equipped wrecking company were at hand to salve her. The wreck of the bark *Gifford* is an example of what might be done on this coast by such a company; the *Gifford* was abandoned after a slight attempt was made to float her.

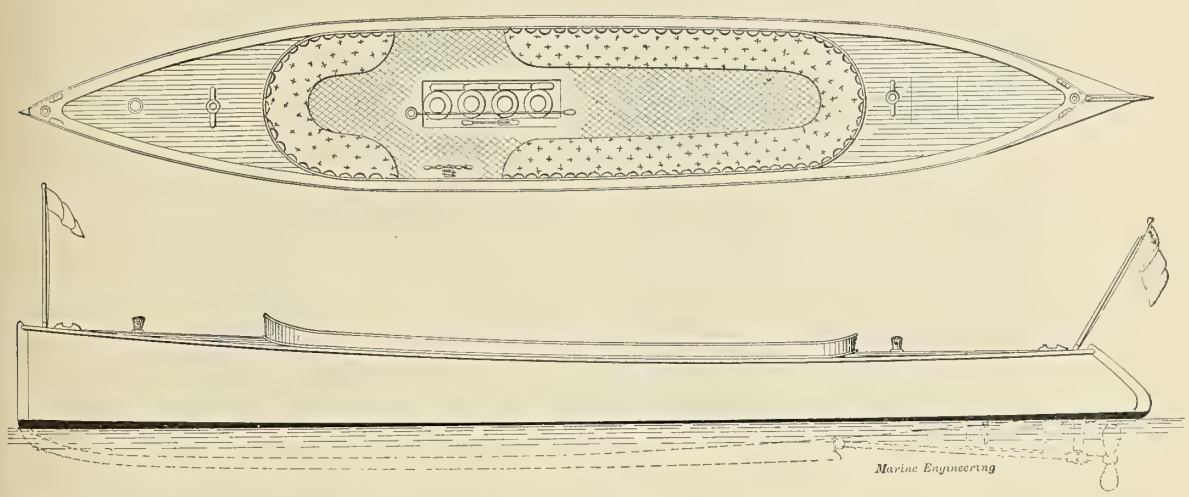
32-Foot Speed Launch Eusonia.

An incident which further attests the lead of the American launch builder is shown in placing the order for the speed launch *Eusonia,* for Felix Fournier, of Paris, France, with the Matthews Boat Company, of Bascom, Ohio. The boat is to be used during the coming season in the races of the Association Canots de France. The accompanying drawings clearly show the lines, construction, and appearance of this craft. She is 32 feet over all, yet her water-line length is but 29 feet 11 inches, which will bring her within the 30-foot class. When the boat is in motion she will, of course, have advantage of her greater overhang length. As is seen from the lines full buttocks are carried well aft, making her a roomy craft. The deepest part of the hull is forward of the engine, the keel gradually rising in an almost flat curve until it strikes the water line aft.

The keel, stem, and frames are of white oak, the latter of 5-8 by 1 1-2 inch. The details of construction of the keel, stem, and stern are shown in drawing on

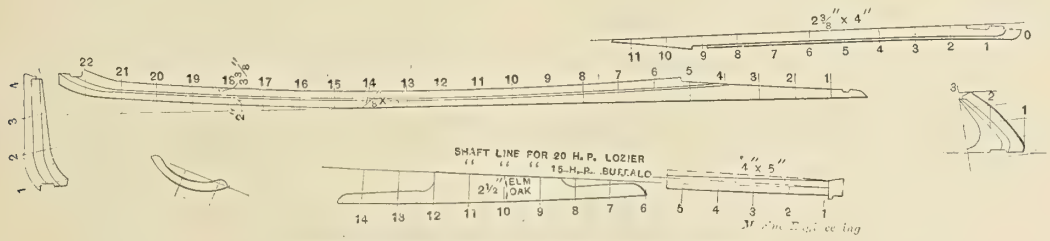


INBOARD PROFILE AND DECK PLAN.



GENERAL ARRANGEMENT AND OUTBOARD PROFILE 32-FOOT SPEED LAUNCH EUSONIA, BUILT BY MATTHEWS BOAT COMPANY FOR EXPORT.

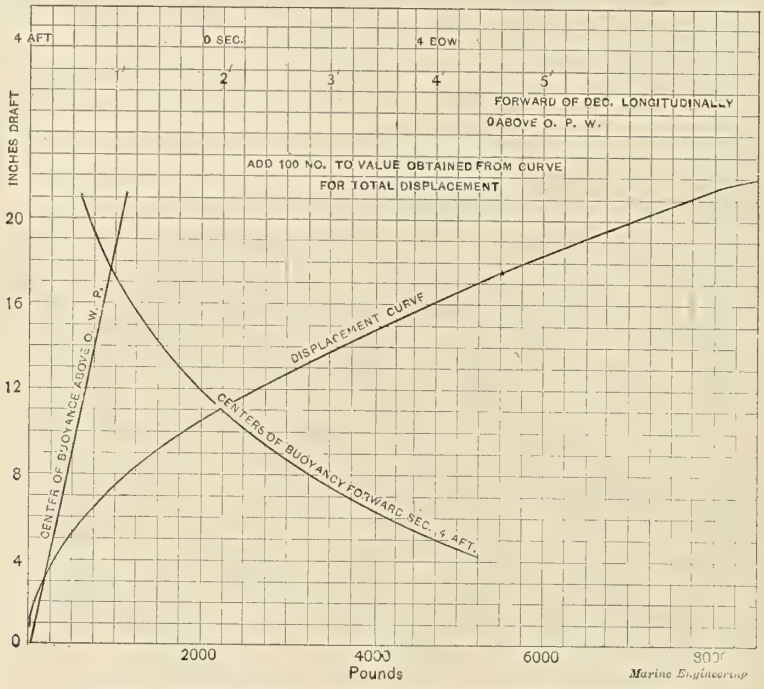
this page. The members are securely held together, and with the deep floors the boat will be of strong construction. The planking is 9-16 inch copper fastened throughout. The deck and plank shear are of 1-2 inch mahogany, and the combing is of quartered oak 7-16 by 6 1-2 inches at the ends. The cockpit is staved in 3-8 inch mahogany brass fastened, and the floor is of 5-8 inch white pine with brass screws and covered with linoleum. Lockers are placed under all the seats in the cockpit. The polished brass steering wheel is placed amidships, and a bronze chain cable connects with the tiller; the rudder is partially balanced, 2 feet 2 inches long, placed forward of the propeller, and is of Tobin bronze plate.



DETAILS OF STEM, KEEL, AND STERN OF THE EUSONIA.

The outfit and trimmings are as follows: two pairs of polished brass chocks, two oak towing posts, two flagpoles with brass sockets, polished brass stem and stern bands, and a spray hood. There are also polished brass hatch lift and boat hook, fenders, and mooring lights. The hull is painted with two coats of copper paint below the water line, four coats of white above the water line, and one of enamelette. Decks and interior, four coats spar varnish.

The boat is driven by a 25-horse-power, 4-cycle Lozier, 4-cylinder engine, fitted with reversing clutch, and all parts made as light as possible. The fittings are of brass for salt-water service. Because of the form of the stern, as above noted, it will be possible to apply a high power without causing the stern to settle. Also the strong construction will prevent undue vibration.



CURVES OF DISPLACEMENT AND BUOYANCY FOR SPEED LAUNCH EUSONIA.

light construction as consistent with necessary strength. There are two high-pressure engines driving the stern wheel; the cylinders are 9 inches diameter by 48 inches stroke. The principal parts of the machinery are of semi-steel. The boiler is a 36-inch locomotive type firebox, carrying a steam pressure of 200 pounds. The engines and boiler were built by the Willamette Iron and Steel Works of Portland. The boat, which is operated by the Northern Commercial Company of San Francisco, has now been in service for two years, and it is stated that no parts of hull and machinery have shown signs of weakness.

During the first year of her service, which, of course, was limited to a short Alaskan season of 77 days, she traveled 10,000 miles, against as swift and shallow water as has ever been navigated in any part of the globe, and this, too, under load conditions varying from 30 to 70 tons. She has just concluded her second year's experience under the same conditions, having gone a distance of 12,000 miles, and although subjected to much hard usage, she has been demonstrated a complete success.

The illustration is from a photograph taken of the steamer just after her initial plunge into the waters of Fifty Mile, at White Horse, Yukon Territory. The top of the dark water line is 12 inches above the lowest portion of the hull, her draft at that time being 9 1-2 inches aft and 6 inches forward. With steam up, and four tons of fuel, all equipment, furniture and stores on board, her draft was 10 inches aft and 8 inches forward. She took on at White Horse stores for three months and freight amounting to 55 tons weight, and with a draft of 18 inches even keel, proceeded without any preliminary trial on her maiden voyage of 2,000 miles to the town of Bittles, Alaska, above the Arctic circle, where she was in continuous service during the season of 1902. During this season, the lowest water ever known

Light-Draft Steamer for an Alaskan River.

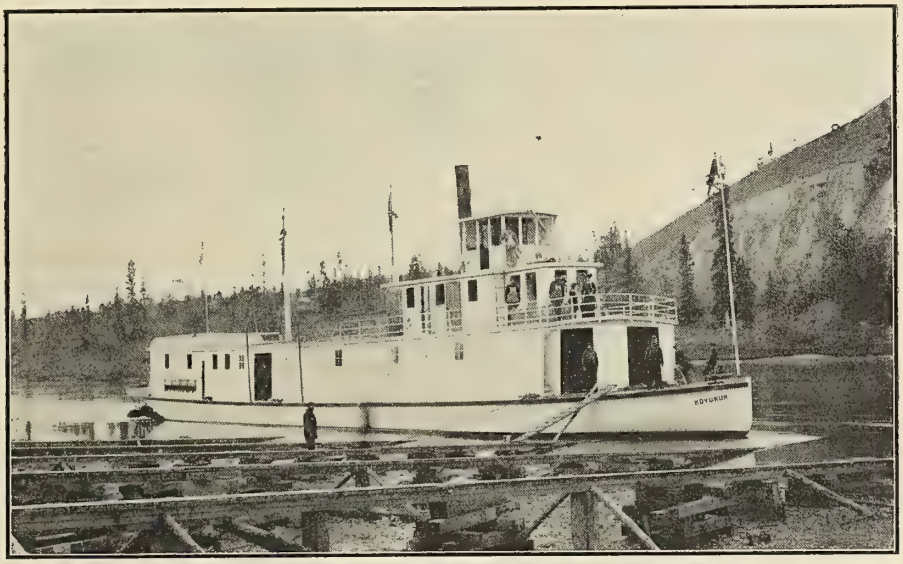
A boat here illustrated, and for service on the Koyukuk river, possesses some special features of construction which, it is stated, are entirely novel. The river is full of rapids and shallow water, and is extremely difficult of navigation by any ordinary craft. So it was decided, on building the *Koyukuk,* to construct a hull with a certain amount of flexibility to overcome the danger of straining, resulting from the almost certain grounding attending navigation in these shallow waters. Lightness of construction was another prominent feature, and it is claimed that this boat is the lightest draft serviceable steamer of the size ever built. She is 120 feet long, 24 feet beam, 4 feet molded depth, and the load draft is but 18 inches. The hull, which was built by Joseph Supple, was erected first at the shipyard in Portland, Oregon, then "knocked down" and shipped to White Horse, Yukon Territory, where the parts were again assembled, and the vessel launched.

In the machinery of this boat the design called for as

prevailed, the Koyukuk river being from 2 1-2 to 3 feet lower than any previously observed stage.

As before noted, she carried from 30 to 70 tons each trip, taking 30 tons up stream against swift water of 16 inches depth. At one place, known as Crimmins riffle and Gold Star bar, the fall is 25 feet in 3 miles. The *Koyukuk* ascended this heavy grade with 60 tons of freight, without landing at any point. At other times she has been blown out of her course and saddle-backed across the head of bars which only had 6 inches of water over them, and has even passed completely over them broadside, backing up the gravel on the lower side until it was over 4 feet high.

One of the most satisfactory results of the building of this craft was the restoration of confidence of the miners of the Koyukuk district in the ability of the transportation company to keep up the supply of food, clothing and machinery, which had been dangerously uncertain until the advent of this steamer.



LIGHT-DRAFT STEAMER LAUNCHED ON THE KOYUKUK RIVER, ALASKA.

The Laying Up and Storing of Small Yachts for Winter.

BY FREDERIC S. NOCK.

The laying up and storing of yachts for the winter months involves more than is generally supposed by the average owner. Where a crew of one or more are kept the captain usually looks after a number of the necessary details, but to the small yacht owner in general it is a case of leaving the boat with some builder, and he then thinks little or nothing about her until the weather begins to get warm again, when he gives orders to have his boat put in commission. He probably is not aware of half that has to be done to her in order to keep her in proper condition for the winter—how she is hauled out or laid up. Many people imagine that a small boat has to be hauled out on the marine railway just as if the boat was to be cleaned and painted, and I have often been asked, "How do you get them off the cradle and put them where they are?"

There are a number of ways of hauling out boats, but undoubtedly the simplest method, especially where the boat is of shallow draft with keel the full length, as in the old type, is to haul it up on rollers. This method is not so convenient when it comes to hauling out a boat of modern type with a keel of from four to eight feet in length on the foot and of a draft of six feet or more. Then some builders use a carriage with uprights on each side that can be removed; on the top of this carriage is fastened a smaller cradle made of spruce joist running fore and aft with the ends slightly rounded, similar to the runners of a sled. Securely fastened to these fore-and-aft pieces are heavy cross timbers whose dimensions depend upon the weight of the boat which they are to sustain. The large carriage, with the small carriage or cradle secured to it, is run down the inclined track, thus submerging the cradle. The boat is then floated into position directly over and amidship of the cradle, being guided by uprights or some suitable mark; then the craft is guyed up and secured fore and aft with lines. The main carriage is now hauled up the track which brings the boat out of water. She is now shored and braced to the small cradle and then slid with the cradle from the carriage. This cradle is kept under the boat until the boat is again launched.

Another and practically the same method of hauling these keel boats is to ballast down in position at low tide a suitable carriage, either made up as aforementioned or as follows: Heavy timbers are laid crosswise and held together by two lengthwise strips on top and four on the bottom; two of the bottom strips are placed near the outside ends of the cross pieces and about twelve inches on each side is fastened another strip; these are to be used as guides to keep the carriage on the stationary track or skids. At high tide the boat is floated into position and made fast, and as the tide leaves her she rests in the cradle; then she is shored as in the aforementioned method and hauled to the desired place. Some builders prefer this method as there is less friction on the underside than there would be if the pieces the full length of the carriage rested upon the greased wood track or skids. Where the stationary track ends it is customary to use pieces of spruce planed smooth and kept well greased to move around to any desired place. A very

heavy craft is sometimes left on the last two skids, otherwise she is raised a trifle and the skids taken out from under the carriage, which latter should be left in such a position that the boat rests on the same level as she would float; this insures the proper drawing off of any water that might accumulate in the cockpit as it would run through the scuppers instead of settling at the opposite end and freezing up solid, as happens only too often.

One well-known firm of yacht builders has a very good method of hauling, which is nothing more or less than a system of tracks through the yard connected to the railway tracks. A boat is drawn out on a cradle resting on a carriage equipped with flanged wheels and the carriage, cradle, and boat hauled to some convenient spot in the yard and left until launched in the spring. While this is a good system it is very expensive.

When the boat is properly shored up the next thing to do is to unbend the sails; they should be thoroughly dried and stored in a dry place. When stripping the rigging care should be taken that all the parts are clearly marked where they belong. The spars should also be stored away where they will be protected from the weather. As to the mast: this on large boats is seldom taken out, but among the smaller craft the custom is to take it out. When left standing the mast should be well protected by a good coat of varnish, a coat of white lead, or ochre and lard, or, again, some masts are carefully wrapped with canvas.

The inside of the craft demands attention, for after the fittings and furnishings are taken out all the plumbing, tanks, waterclosets, and lavatories should be carefully inspected and the water drawn from same in order to prevent freezing. The plugs should be drawn out of the hull. It is an excellent plan to thoroughly clean out all the dirt and mud that has congregated around the heels of the frames and floors and clean and thoroughly rinse out the timbers. If a hose is handy it greatly facilitates matters, and the boat is then sweet and clean, instead of being chocked up with pieces of frozen mud.

Should the boat have decks, and other exterior woodwork finished bright, it may be necessary to give them a coat of good spar coating before she is covered up, though the condition of the varnish work at the time she was laid up would show whether this was necessary or not.

A piece of scantling should be set up amidship to form a ridge pole and over this the canvas for covering should be stretched, care being taken to have sufficient pitch on the sides to shed the rain and snow. One essential thing that is overlooked by many is the necessity of having a circulation of air through the boat in order to prevent sweating which will otherwise occur. The forward ports or hatch should be open, and where it is possible there should be a circulation of air under the cockpit and after deck; it is also a good plan to leave all locker doors or lids partially open, and if any of the locker doors are fitted with mirrors they should be removed and placed in a dry place.

The same suggestions apply to the laying up of gasoline launches as well as sailing craft; all water should be drawn off from the cylinder jackets and out of the pipes; all fittings liable to rust should have a good coat of cosmoline or a similar substance, and the inside of the cylinders should be given a coating of heavy oil. This oil is easily gotten rid of when desired by putting in each cylinder a small quantity of kerosene. Spark coils, sparking dynamos, or magnetos, should be disconnected and stored in a dry place. If common dry batteries are used the probability is that at the end of the season they are of little or no use; if the batteries are of the Edison-Lalande type it is well to pour out the potash and thoroughly clean them, and if the zinc and copper oxide are in good condition a fresh charge of potash with a few ounces of paraffine oil on top of same is all that would be needed in order to put them in good condition again.

Where the craft hauled out is equipped with a steam engine the engineer usually looks after all that is necessary to do in order to leave the machinery and boilers in proper condition for the winter. Most of the large craft are kept in the water all winter, and in some cases the owners of small craft prefer to have their boats laid up in that manner. It is then necessary to close the sea cocks, and, unless the boat in question is some large yacht that is to be kept warm all the season, to draw off the water.

Where a boat is fitted with a water-tight or self-bailing cockpit some provision must be made to prevent the scupper pipes from freezing; this can be done by putting a piece of rope through the pipe and leaving it there in such a manner that it cannot pass out of the pipe. Where the scuppers are very large a piece of rubber hose pipe carefully plugged is inserted in the pipes, and then if there is any tendency for the water in the pipes to freeze the pressure formed thereby exerts its energy upon the hose pipe. Among the large yachts it is customary to cover them in with boards, and in many cases they are housed in with a substantial wooden structure.

These particulars are intended for yachts of wooden or composite construction, yet where a yacht is built of steel or iron the only material difference would be that the metal work should be well protected with paint and no bare places left for the weather to rust.

Sectional Boat for the United States Army Transports.

There has just been completed for the United States Army transport service a boat of novel construction, built on the sectional plan. In order to expedite the landing or embarkation of men and munitions in our insular possessions it has been found necessary to have a larger tender than that which can ordinarily be carried on the davits of transports, and therefore there was undertaken a new type of sectional boat to meet the special requirements. Many sectional boats have already been constructed, and some of large size, but in this case it was necessary to have a boat that could be very quickly assembled away from a shipyard, and the assembling must be done at times in a heavy sea and after the sections had been separately launched from the transport.

The War Department issued a call for bids, stipulating the requirements, and leaving it with the bidders or builders to make their own plans and specifications. The proposal from the Gas Engine and Power Company

and Charles L. Seabury and Company, Consolidated, at Morris Heights, was accepted. The boat built, named the *Pontonier,* is seen in the accompanying half-tones.

There were some special perplexing features which are not evident at first thought. The different members or sections, each of different weight and size, and different weight of equipment, would naturally have different displacement and trim when afloat, yet they must be brought to a common water line before attaching to each other; each must have sufficient strength and buoyancy

The bow section is comparatively short, carrying derrick and the anchor equipment, with chain and store lockers inside. The quarter section, or that next the bow section, serves both as a hold for the cargo and as quarters for the crew—in fact, will berth twenty men if required. The third section carries a Seabury water-tube boiler, the coal bunkers, and a portion of the water storage. Her coal capacity will be 13 tons, giving her a liberal running radius. On the top of this third section is also fitted a pilot house, which is portable, with or

SECTIONAL BOAT PONTONIER, BUILT FOR THE UNITED STATES ARMY TRANSPORT SERVICE.

to float when in the sea before assembling, and must be so fitted as to permit of quickly assembling in rough weather. The general dimensions of this boat are as follows: length over all, 80 feet; beam, 18 feet; draft, loaded, 3 feet 6 inches; corresponding displacement, 72 tons.

The light draft is essential as the boat will be used for embarking and disembarking men, munitions, etc., in shallow waters. She is of steel construction throughout with angle frames and stringers, girder or plate keel and keelsons inside, and plating of 1-4-inch ship steel with lap-joints. With the steel deck each member becomes water-tight or box-like in form.

without which the vessel may be operated. The section next aft the boiler, or fourth section, will carry the driving power intact, consisting of two compound engines, which have 6- and 12-inch by 9-inch cylinders, their shafts, and the propellers, thus keeping them in perfect alignment and without danger of being disturbed. A portion of this section, measuring 11 feet 6 inches fore and aft, is cut off with an inside bulkhead to give quarters for the officers. The fifth section composes the oval counter which may or may not be used. As this section comes above the water line its omission gives the vessel a square stern effect.

In assembling the vessel the boiler section is first

floated, for as it has the greatest weight it establishes the water line; then the others follow in order, working either fore or aft. They are fitted with sea valves and sea water is admitted into their bottoms until they reach the common water line. Two sections coming together have their ends fitted with cones of about 14 inches diameter, one set pointing inward, the opposite pointing outward. On the deck of each section is fitted a small windlass with a steel cable which works on a differential system. The cable connects cones of one section to those of the other, and the windlass being operated brings the four cones together, one from each section engaging that of the one adjoining. When all have been secured the water ballast is removed by steam syphon

ELECTRICITY ON SHIPBOARD.—IV.

J. W. KELLOGG.

As an example of an electric installation on shipboard that would be practicable at the present time, let us assume a steamer about 350 feet long, 40 feet beam. with freight and passenger accommodations. Longitudinal section and plans of this steamer are shown in the drawing on page 75.

There would be installed 400 incandescent lamps, one searchlight, three cargo winches, two capstans, one anchor windlass, steering gear, and four ventilating fans operated electrically. Four 30-Kw. 125-volt generators, directly connected to four vertical tandem compound engines, would supply current to this equipment.

ASSEMBLING SECTIONAL BOAT PONTONIER.

connection and they are reinforced by connecting bolts, one section to the other. The boat is now ready for use as soon as the steam connection between the engine and boiler sections can be coupled and the piping for the feed water connected to the pumps.

When required to be taken apart for reloading on a transport, the operation is simple, involving only the breaking of the steam pipe and feed-water connections, removing the bulkhead stay bolts, and relaxing the cables holding the cones. To demonstrate that the parts could be quickly assembled or taken apart, a trial was made at the works of the builders. The vessel was built on ways, as is usual, and launched; then the sections were disconnected, as shown in the engraving, and quickly reassembled, the demonstration being satisfactory to the government officials. The *Pontonier* has been sent to Washington where she will be used temporarily for drilling until assigned to one of the transports.

The dynamo room is located on the plans just aft of the main engines on the platforms between decks. Current is distributed from a 12-circuit switchboard, on which provision is made for connecting the generators so as to obtain 125 and 250 volts; the lighting, windlass, and steering gear feeders to be 125 volts, and the winches, capstans, and ventilation fans to be operated on the three-wire system normally at 250 volts. It is intended to operate the windlass and steering gear from individual generating sets, which, when so used, will have no connection with the lighting or power system. The diagram of the switchboard connection is given on page 73.

Machines Nos. 1, 2, 3, and 4 are connected to four switches, A, A, A^1, A^1, which are double-pole, double-throw. When these are thrown down either 1 or 2 may be thrown on the windlass circuit, and 3 or 4 on the steering-gear circuit; when thrown up they distribute

current to four double-pole, double-throw switches, *B, C, D, E*. If these are all thrown in one direction the machines operate in parallel on the 2-wire system. If *B* and *C* are thrown up and *D* and *E* down, machines 1 and 2 operate on one side, and 3 and 4 on the other side of the 3-wire system; so that any combination of the machines can be made on the 2- and 3-wire system by means of switches *B, C, D,* and *E*, and the equalizer switches at the bottom of the diagram.

It is not expected that the winches will be in operation at the same time as the steering gear, and at no time in actual service would current be required for more than 50 per cent. of the total requirements of the plant with all apparatus operating under full-load conditions. It is probable that the ordinary requirements would be about 25 per cent. of the total.

While at sea two machines on the 3-wire system and one on the steering gear would be normally in operation

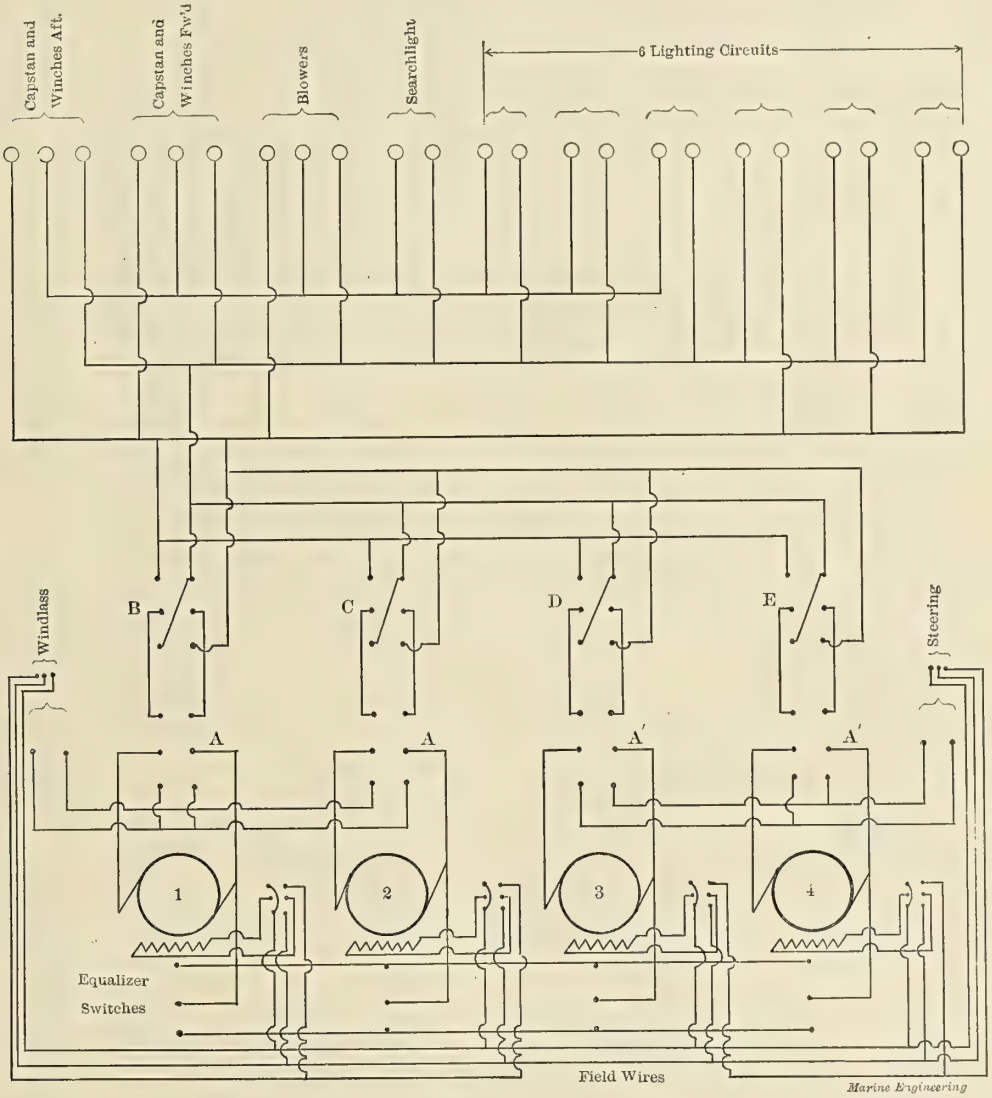


DIAGRAM OF WIRING FOR ELECTRIC LIGHTS AND MOTORS SUITABLE FOR SMALL STEAMSHIP.

The searchlight and three of the six lighting circuits are connected to the upper bus, the remaining three lighting circuits being connected to the lower set of bus bars. Three-wire circuits are used for the blowers, winches and capstans.

Three sets of field bus bars are provided, and double-pole, double-throw switches for each machine, so that one set of bars can be used for constant excitation of the field, and the other for the variable excitation which is required when the generator is running on the windlass or steering-gear circuit.

when lights were used. When ship was at dock two machines, and possibly four, would be connected to the 3-wire circuits.

The rated capacity of the four generators would be about 160 horse power, but they could be operated at 200 horse power under such conditions as would exist while the ship was loading or unloading at dock. The winches would require a maximum of about 75 horse power, the capstans, steering gear, and windlass each about 50 horse power, lighting, searchlight, and ventilation about 75 horse power.

The distribution of the lights would be as follows:

Shaft alley	9
Dynamo room	8
Engine room	20
Boiler room	8
Cargo spaces, five 4-light clusters	20
Fixed lights	20
Saloon, main deck	85
Forward, "	16
Aft quarters	30
Saloon, lower deck	59
Forward, "	20
Cargo	6
Outside, upper deck	25
Smoking room and state rooms	50
Wheel room, captain's and officers' quarters	18
Running lights	6

The main switchboard would be located in the dynamo room, and the twelve circuits arranged as follows:

SIX-LIGHTING CIRCUITS.

No. 1. Lower-deck quarters.
" 2. Engine and fire rooms and shaft alley.
" 3. Main-deck saloon.
" 4. Freight spaces and main deck aft.
" 5. Boat-deck quarters.
" 6. Running lights, deck lights, and fields of the motors operating on 250 volts.

OTHER SPECIAL CIRCUITS.

" 7. Searchlight.
" 8. Windlass.
" 9. Capstan and winches, aft (*C* and *B*).
" 10. Capstan and winches, forward (*B* and *D*).
" 11. Blowers.
" 12. Steering gear.

Circuit No. 1 would run from the dynamo room to a 10-circuit panel in the passageway in the state room spaces on the lower deck and divide, supplying light for the state rooms, passages, and crew's quarters on the main and lower decks; the saloon lighting requiring seven circuits, the forward compartments two, and the cargo one. This circuit would consist of 40,000 c.m. wire composed of nineteen No. 17 strands, and would be run from the switchboard in conduit through the bulkhead forward of boiler room, and from there in moulding to the panel board.

Circuit No. 2 would run from the switchboard to an 8-circuit panel board placed in the engine room just outside the dynamo room supplying current for one circuit for shaft alley, one for dynamo room, one for boiler room, three for engine room, and two for cargo. All would be run in iron pipes with steam-tight fixtures, the main wire being 21,000 c.m. of seven strands No. 15.

Circuit No. 3: From the dynamo room to the pantry, with a 15-circuit panel just aft of the stairs on the main deck; eleven circuits to the saloon, two for the cargo spaces, and two for crew's quarters forward. This would be 50,000 c.m., 37 strands of No. 18, and would be run in conduit from switchboard to panel board.

Circuit No. 4 would run from the dynamo room to the after quarters on the main deck in iron piping to a panel board with four circuits. The size of the main would be 6,530 c.m. cable, seven No. 19 wires.

Circuit No. 5 would run from the switchboard to the bulkhead just back of the main-saloon entrance on the upper deck to a panel with nine circuits; three for smoking room on upper deck, three for state rooms, and three outside. The main would be 26,250 c.m., nineteen No. 18 strands, run in iron conduit.

Circuit No. 6 would be of 6,530 c.m., seven No. 19, run in iron conduit from the dynamo room through the passage way in the house on the aft boat deck to a 4-circuit panel; three for officers' quarters and one for running lights.

Circuits Nos. 5 and *6* will each have an additional switch on the panel for field circuit for motors.

Circuit No. 7 would be of seven No. 19 stranded cable, running in conduit direct from the dynamo room to the searchlight.

Circuit No. 8, for the windlass, would run in conduit, and be of 500,000 c.m., with two field wires.

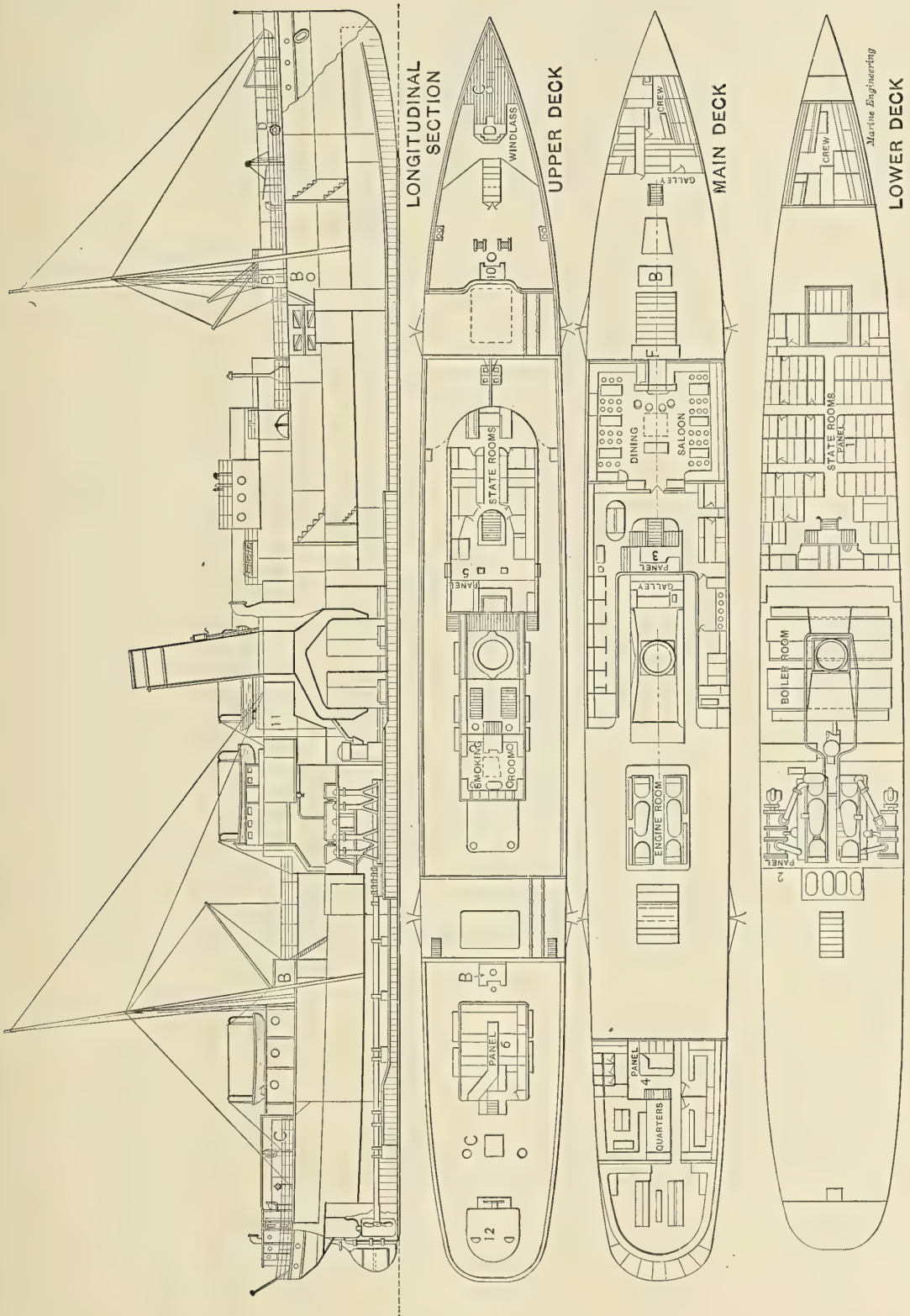
The method of operation of the windlass is as follows: The armature circuit of the windlass motor is connected with the armature of generator 1 or 2 by throwing down switch *A* and closing the windlass-circuit switch; the fields of the generator not being excited until the operator at the windlass is ready to start, at which time the fields are strengthened until the motor is up to speed. If thereafter any excessive strain is put upon the motor, by reason of the anchor holding, the capacity of the generating set is such as to make it impossible to overload the motor unduly. The speed of the engine will drop and lower the voltage of the generator, reducing the speed of the motor. If the strain is sufficient the motor will be stalled, and as the anchor releases, or the ship makes slack chain, the engine speed will pick up, raise the voltage of the generator, and speed up the motor until the load again becomes too great, when the motor will be again slowed down. The action is thus practically the same as on the present steam windlass, and is a perfectly safe and simple arrangement.

It would appear that the anchor gear is one of the first auxiliaries to which the electric motor should be applied, as the troubles incident to the connections of a steam windlass are many.

Circuits Nos. 9 and *10* would be each of 250,000 c.m., run in conduit direct to the controller for the machines. The motors would be enclosed, water-tight, with cylinder controllers of the street-car type.

For the winches it is generally sufficient to install a foot brake, but with electric motors, on account of the possibility of interruption of current in the circuit, it is desirable to have an automatic brake that will prevent the load from descending in case the current is cut off from the motor. There are several forms of these automatic brakes, the most common being a solenoid band brake that is held off as long as current is at the brushes of the motor.

Circuit No. 11, for ventilation, will be 200,000 c.m., run in conduit from the switchboard to the blower room on upper deck in spaces over the boilers. There are two steel-plate fans here, driven by shunt motors. Current is also distributed from here to two cast-shell fans, one for aft quarters and one for crew's quarters, forward. The air supply on the steel-plate fans is regulated by varying the speed of the motors from full speed to half-



PLANS OF SMALL OCEAN STEAMER, SHOWING ARRANGEMENT OF SWITCHBOARD PANELS.

speed, and also by field control of the motors between these two speeds.

Circuit No. 12: The steering gear is operated from a 500,000 c.m. circuit, running in conduit from the switchboard direct to the steering room on the upper deck at 12. Controlling circuits are run to pilot house and bridge.

FROM SEA COAST TO LAKES.

BY C. A. MCALLISTER, CHIEF ENGINEER, U. S. R. C. S.

In speaking of a trip from New York to Milwaukee, Wis., one would naturally associate with it a 30-hours' ride on a train, with the smoke, dust, and other annoyances or inconveniences incidental to a railroad trip of that length. Rarely does it occur that an opportunity is offered to make the passage between the two cities entirely by water; yet such an opportunity was afforded to the writer on the recent voyage of a small government vessel between the two places mentioned. To one not familiar with "a life on the ocean wave," on the great inland seas of North America, such a trip presents some rather novel features. The following notes and observations may, therefore, prove of interest to marine engineers and to seafarers in general.

The ship in question was constructed at a coast shipyard, and although primarily designed for service on the Great Lakes, is fitted with a surface condenser and other apparatus such as is customary for service on salt water. In general dimensions the vessel upon which this trip was made is 178 feet long over all, 30 feet beam, and has an extreme draft aft of 10 feet 6 inches. Her displacement was about 720 tons, and when her engines develop about 1,500 indicated horse power she can steam fourteen knots, but her usual cruising speed was from 11.5 to 12 knots.

The vessel left her anchorage off Tompkinsville, N. Y., late on the afternoon of September 10th, and passed up through the East river and Hell Gate into Long Island sound. The following morning we passed through Vineyard sound, and at one o'clock in the afternoon passed Pollock Rip lightship, from whence the course was laid for Cape Sable, Nova Scotia. At 9 o'clock on the morning of the 12th Cape Sable was abeam. From that time until noon the following day was spent in running along the coast of Nova Scotia, about ten miles off from the headlands.

Entering the Gut of Canso shortly after noon on Sunday we began the interesting part of the trip. This narrow strait—in some places it is less than half a mile in width—is bordered on each side by rich farming communities. One noticeable feature was the large number of neat white churches, apparently one-third of all the buildings in sight being places of worship. Port Hawkesbury, on the Nova Scotia side of the Gut, appeared to be the only town of any size, it being the place where the railroad trains were ferried to and from Cape Breton Island on an enormous ferryboat, which has the distinction of being fitted with four smoke stacks. The run through the Gut occupied about two hours, and the course was then laid up the Gulf of St. Lawrence.

The St. Lawrence river is supposed to join the Gulf at Gaspé Head, but just why the distinction is made at that point is difficult to imagine, as Anticosti island, the nearest land on the north side of the river, is about sixty miles away. We were abeam of this point at 8 o'clock on the morning of the 14th. Since leaving New York we had encountered weather conditions of the very finest, but as soon as we started up the river a fierce northwest gale set in, and as the tide was then making flood, a very nasty head sea was encountered. As but little headway could be made on account of the violent racing of the engine, we turned back and found a very smooth anchorage in Gaspé bay. Here some members of the crew, with Izaak Walton tendencies, soon caught a fine mess of rock cod. At the entrance to this bay we saw what is probably one of the smallest lightships in existence, as she was scarcely forty feet in length, and had been evidently a small sloop earlier in her career. In this connection it should be said that the Canadian government has been very liberal in its appropriations for aids to mariners, as all of the waters through which we passed were as well buoyed and lighted as American waters.

Early in the evening, the gale having moderated, we got under way and again started around Gaspé Head, this time finding the sea quite smooth. It was noon on the following day before the river had narrowed down sufficiently so that land could be sighted on both sides, and it was 8 o'clock on the next morning before we anchored in the river off Quebec. We were now in fresh water, and the trouble and annoyance of keeping salt water out of the boilers were at an end. Only those engineers who have had a regulation against the use of salt water in boilers to contend with, and who have been compelled to sound tanks and run an evaporator for the make-up feed at sea, can fully appreciate what a luxury it is to have an unlimited amount of fresh water to draw upon for boiler-feeding purposes.

We stopped at Quebec for an hour only, and with a new pilot were soon headed up the river again. We now had a steady head current of varying velocity to run against. In several places the river widens out, and such localities are graced with the title of lake. Notable among these is the Lac St. Pierre, through which we ran at about sundown. A passing wood scow called to mind the famous poem about the lamentable wreck of the Julie Plante when "The wind she blow on the Lac St. Pierre." At 11 in the evening we arrived opposite Montreal, and as the current is so swift along the river front, and the docking facilities very limited, we at once entered the Lachine canal, and passing through two locks, were lifted about 20 feet above the river level, where we found fine wharfage facilities in one of the slips branching off the canal, right in the heart of the city. We had now completed the first stage of our journey, having traveled a distance by log of 1,720 statute miles from New York city. As there are excellent facilities for coaling ship in Montreal, the coal bunkers were filled with American coal, which we were enabled to buy out of bond through the courtesy of the Canadian officials. The men employed in coaling were French-Canadians, who used small, bowl-shaped baskets, each only holding about a good-sized shovelful. Notwithstanding the diminutive size of the baskets, the coal was put in the bunkers very rapidly, and with an unusually small amount of dust and dirt.

Before entering upon a description of the remainder of the trip it will be well to state that Montreal is practically the head of natural navigation on the St. Lawrence, as the Lachine rapids end almost immediately opposite the city. From Montreal to Ogdensburg, N. Y., there are a series of rapids in the river which make navigation up the stream impossible, and down navigation extremely hazardous. To get safely around

these rapids the Canadian government has established a number of canals and locks so that safe passage in either direction can be had by using the river between the rapids and the canals around them.

The total distance between the two cities mentioned is 119 miles, of which practically 44 miles consists of canals. Naturally the smallest lock in the entire system determines the extreme size of vessel which can safely pass through; up to two years ago the smallest lock was the Morrisburg, No. 23, near Montreal. This lock was suitable for propellers 185 feet long, 25 to 30 feet beam, and drawing not over 9 feet of water. At the outbreak of the Spanish-American war, when the government decided to bring the Lake-built revenue cutters *Gresham, Onondaga,* and *Algonquin* to the sea coast, it was then necessary to cut them in two and pontoon the two sections all the way from Ogdensburg to Montreal, on account of this one small lock. At the present time the Beauharnois canal, in which the Morrisburg lock was situated, is not used, and a new canal, the Soulanges, with larger locks, has been constructed on the opposite side of the river. It is now possible for vessels 250 feet long, 42 feet beam, and 14 feet draft to travel safely throughout the entire system. These canals have generally a width of 100 feet at the bottom and 180 feet on the surface, and a depth of about 14 feet. Whereas there formerly was a canal toll of 2 1-4 cents per registered ton, the navigation is now free through all the Canadian canals and locks. Too much cannot be said in praise of the substantial manner in which the new canals and locks have been constructed. The locks are of granite and for the entire length of the new canal the sloping sides are built of stone. The lock gates are operated by electric motors and the entire length of the canal is thoroughly lighted by arc lights of 2,000-candle power each, about 150 yards apart, so that navigation by night is as safe as by day. The electricity is, of course, generated by water power from the rapids in the river. Everywhere we were impressed by the business-like way in which the locks were operated. We would steam right into the lock, make fast our lines, the lower gates would be swung silently shut, and the flood valves in the upper gate would be quickly opened. The lock would be filled in very quick time, four or five minutes being all that was necessary to lift us, in some cases, 20 feet, to the next level. There are altogether 21 locks between Montreal and Ogdensburg, and the total difference in level is about 222 feet. In the canals we were allowed to use our own steam, the speed being restricted to four miles an hour.

ST. LAWRENCE RIVER AND THE WATER FRONT OF THE CITY OF QUEBEC.

As the weather conditions were of the finest no pleasanter trip can be imagined than steaming slowly through the rich agricultural country traversed by the canals. As it was early autumn the orchards were laden with the choicest apples, peaches, and pears; in some places the trees would overhang the banks of the canal. Frequently the farmers would good-naturedly throw fruit aboard to the sailors, who, needlessly to remark, were willing recipients of such favors. Canadians are, as a rule, strict observers of the Sabbath,

and the canals are not operated on that day from 6 A.M. to 9 P.M., so as we had left Montreal on a Saturday morning we were obliged to tie up in the canal at the city of Cornwall over Sunday. The total steaming time from Montreal to Ogdensburg, a distance of 119 miles, was 20 1-2 hours, which, in view of the number of locks and the speed restrictions in the canal, shows the rapidity with which the locking was accomplished.

Arriving at Ogdensburg an opportunity was afforded for thoroughly cleaning the boilers. The river at this point is quite wide and the docking facilities excellent. We found the water so clear that objects on the bottom could be plainly seen at a depth of 20 feet. With this unlimited supply of pure, fresh water at hand, boiler cleaning was, as can be easily imagined, greatly facilitated.

On September 26, having completed overhauling the machinery, we left Ogdensburg at 9 A.M. and steamed up the St. Lawrence river. From here to Lake Ontario is probably the most picturesque part of the whole trip, as the course took us through the whole length of the famous Thousand islands. From the numerous little islets passed en route one can well imagine that there are at least, as the name indicates, a thousand or more of them. Opposite Alexandria bay, N. Y., nearly every one of them is inhabited, and the beautiful summer residences must be seen to be appreciated. One feature of these islands is the large number of what might be termed yacht barns, or storage places for the many pleasure craft. Some of them were large enough to safely house schooner-rigged steam yachts apparently 110 feet long, masts and all.

At Cape St. Vincent, which marks the end of the St. Lawrence river, we stopped a few moments to put the pilot ashore, and then steamed out on the first of the chain of fresh-water seas, Lake Ontario. Those of us who had never before cruised on the Great Lakes were interested to observe the conditions of the sea, etc. We were soon out of sight of land, but as the wind was light no unusual conditions of the sea were encountered, the waves being about of the same size as would be met with on Long Island sound. One of the first vessels we passed was of a type which is now fast disappearing on the lakes, a three-masted schooner. So far as model was concerned she was not unlike the coasting schooners, but her rig was strikingly different. Instead of all three masts being of the same height as on coast schooners they were of different lengths, apparently about the same as square-rigged sea-going vessels, the short mizzen mast being particularly noticeable. She carried one yard on the foremast upon which was bent a square foresail; above the yard was a triangular topsail, the apex of which was hauled up to the fore truck. Another peculiarity in this rig is that the foremast usually rakes forward, the mizzen mast aft, and the mainmast is about vertical. Only one or two steamers were passed on this run, as traffic is not very heavy, for there are no large cities located on Lake Ontario.

The trip from Cape Vincent to Port Dalhousie, at the northern end of the Welland canal, or nearly the whole length of this lake, was made in thirteen hours. As we arrived at the latter port very early on Sunday morning we were again obliged to tie up over the Sabbath owing to the canal regulations. We commenced our journey through the famous Welland canal at daylight Monday morning. Although this canal is only 26.7 miles long there are 26 locks through which vessels must pass, and the difference in the level between the lakes which it connects is 326 feet 9 inches. The locks are of a uniform size, 270 feet in length, 45 feet wide, and 14 feet depth of water over the sills. The country traversed by this canal is probably the richest fruit section in Canada, and as it is very hilly the views from the different levels are superb. About three miles from the summit we discerned a large seagoing steamer apparently cruising along the ridge, traveling through orchards and fields with the greatest ease. When we finally passed her we found that she was an English-built turret steamer hailing from Newcastle-on-Tyne. This passing of two seagoing vessels in an apple orchard on top of a ridge was an experience not met with on every trip by water.

We passed through this canal under our own steam, the speed restriction being four miles an hour. As the banks are lined with broken stone the slight wash from the propeller at this speed had no damaging effect. We arrived at Port Colburne, the Lake Erie end of the canal, after dark in the evening, the run having been accomplished in fourteen hours. We had now reached our level, so to speak, as Lakes Erie, Huron, and Michigan are practically the same height above the sea level, no locks intervening between them. Lake Superior is 24 feet above this level, and to attain this all vessels have to pass through either the American or Canadian lock built by the governments at Sault Ste. Marie.

The run from Port Colburne to Detroit, Mich., our next stopping place, was made in 18 hours, during which time we ran nearly the whole length of the lake. We could now get some idea of the vast amount of commerce on the Great Lakes, for passing Cleveland, Ohio, early in the morning, we met a procession of lake steamers and barges which seemed practically endless. In a four-hour watch no less than 28 steamers were passed going in the opposite direction. They varied in size from the 500-ton lumber steamer to immense ore-carrying steamers 7,000 to 8,000 tons capacity.

The typical lake steamer is, to one accustomed entirely to ocean-going craft, a novel sight. When they are hull down all that can be seen are two houses apparently some distance apart. Upon closer inspection it will be seen that this effect is due to the fact that the pilot house, bridge, etc., are built as far up in the eyes of the ship as it is possible to get them, and the machinery, deck house, and smokestack are just as far aft as possible, the intervening space having no superstructure of any kind, except a long row of hatches, which, of course, do not show above the rail. As the pilot house is so far forward it is naturally next to impossible to steer a straight course with no fixed object ahead to steer by. This is obviated by the use of jack staffs or steering poles, swung out ahead of the stem and in line with the center of the vessel. On the end of this jack staff there is usually a fancy arrow or spear head, round ball, or similar object to steer by. As an Irish fireman rather aptly expressed it, "They look like as if they were going out to fight aich other with spears."

Another object of interest when we came closer to some of the lake steamers was a large pile of coal just forward of the after deck house. Inquiry developed the fact that many vessels carry all their steaming coal on deck, and that it is simply shoveled down into the fire rooms as needed. A coal passer's job is, under such circumstances, much pleasanter than on vessels which carry coal in bunkers.

On our arrival at Detroit, Mich., where we stopped for two days, we had further opportunities to observe the immense size of lake traffic. Seemingly at all hours of the day and night there are vessels going either up or down the Detroit river. It is claimed by statisticians that more tonnage passes Detroit in one year than enters and leaves the ports of New York and Liverpool

TYPICAL THREE-MASTED SCHOONER ON THE GREAT LAKES.

combined. As the year's work on the lakes must be done in practically seven months, on account of the suspension of traffic during the winter season, some idea may be gained of the number of vessels which are constantly passing. For the accommodation of the passing fleet the government has established at this port a marine post office, which simply consists of a small steamer which either runs alongside of each passing vessel or sends a boat off to deliver and collect all mail matter, without necessitating even a slackening of the ship's speed.

Probably one-half of the steamers passing this point have a large barge, or "consort," as they are termed, in tow. Many of these barges are of the "whaleback" variety, a type not wholly unknown on the Atlantic. A noticeable feature on many of these steamers and barges is that they are fitted with hawse pipes and carry anchors at the stern as well as at the bow. As they are frequently compelled to anchor in narow channels on account of blockades and fogs, and as the current always runs in one direction, these stern anchors are great conveniences. The stockless anchors are universally used on all the vessels built within recent years.

While freight steamers compose probably 98 per cent. of all the vessel traffic on the Great Lakes there are quite a number of passenger vessels, and these are fully up to the standard of the best vessels engaged in the passenger traffic on the seaboard. The *North West* and *North Land* are, of course, very well known to people on the coast, but there are two new steamers engaged in the passenger business between Detroit and Buffalo, the *Eastern States* and *Western States,* which would attract attention anywhere. They are large side-wheelers, with compound inclined engines, and are capable of making 19 miles an hour in all kinds of weather. In equipment and general outfit they are the equal of anything that floats.

Speaking of the speed of these vessels reminds me that on the Great Lakes *knots,* or nautical miles, are unknown. All chart distances and all speeds are given in statute miles.

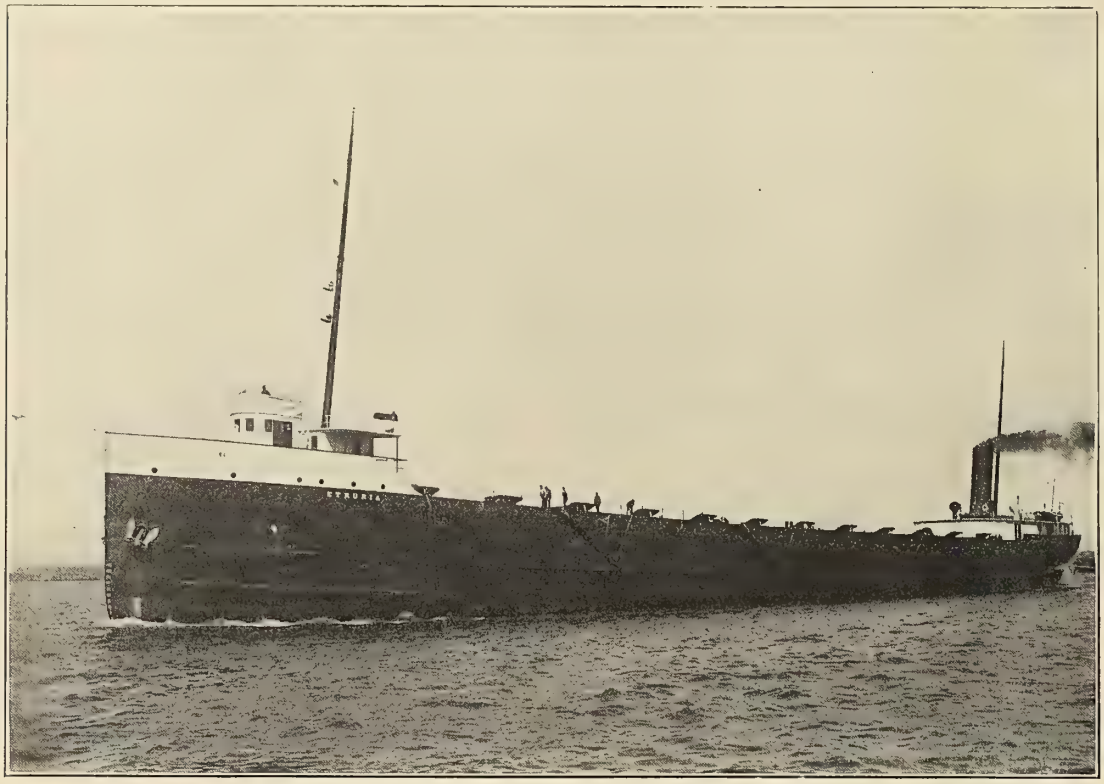
Another peculiarity of interest is the way they have of that on the Great Lakes *knots,* or nautical miles, are of these lake vessels. Instead of using bells, as are almost universally used elsewhere, they have a small, shrill whistle located in the boiler room or other place

THE WHALEBACK ORE CARRIER OF THE GREAT LAKES.

convenient to the engine room. The officer on the bridge simply pulls the whistle rope connected to this small whistle and the following system is adopted. One blast, go ahead; one blast, stop; two blasts, back; three blasts, check or slacken speed in either direction; when repeated, slack more; four short blasts, or one long blast, full speed in either direction. The same system is used for bells, except that the jingle is used for full speed. Fog signals are also somewhat different; instead of one long blast, as is customary on the coast, lake vessels employ three short blasts blown at intervals of one minute. This system enables approaching vessels to exchange passing signals, and in close quarters is found to work very satisfactorily.

We left Detroit for the final stretch of our journey at 7 o'clock on the morning of October 2, and steamed into and through Lake St. Clair, thence through St.

Clair river by Port Huron, and at 1 o'clock in the afternoon entered Lake Huron. The following morning we were treated to a fair sample of bad weather of the Lakes. Just before entering the Straits of Mackinaw we encountered a severe thunder shower which ushered in a gale of wind. The barometer fell very rapidly, at one time going as low as 28.68, which, had it occurred on the ocean, would have caused considerable consternation. However, when we considered our elevation of over 500 feet above the sea level, it did not seem so alarming. For the next twelve hours we experienced about all kinds of disagreeable weather on the catalogue. Coast sailors are apt to refer to what they term "Fresh-water sailors" in a slighting manner, but the writer can



STEAMER ETRURIA, A MODERN ORE CARRIER OF THE GREAT LAKES.

testify from observations gained in that gale, that the seas are fully as bad, even if they are a little shorter, and that just as much seamanship, if not more, is required to safely weather a gale on the Great Lakes as is required under like circumstances on either the Atlantic or Pacific oceans. The wind finally settled into a fresh breeze from the northwest, and the remainder of the run down Lake Michigan was without noteworthy incident. We anchored off Milwaukee, inside the breakwater, the following morning, having completed our journey.

The total distance logged was 2,998 miles, or practically the same length of voyage from New York to Liverpool, but under very different circumstances. While traveling this distance horizontally we had ascended to a height of 583 feet, as the difference in the level between New York bay and Lake Michigan is that amount.

While in Milwaukee an opportunity was had to inspect a modern lake freight steamer of 5,000 tons register which had just been completed. As illustrative of the rapidity of ship construction in Lake yards, it is interesting to note that this vessel was completed and her hold filled with her first cargo within five months from the day that her keel was laid. The engine room contained many interesting features, notably, to us, the jet condenser. To one wholly accustomed to surface condensers the idea of an apparatus about the size of two oil barrels stood on end, condensing all the steam from a 1,600 H. P. triple-expansion engine, seemed quite marvelous. In design, the main engine represented the very latest practice, but in finish it was the acme of simplicity. While everything was provided which would add to its economical operation, nothing was added for purely ornamental purposes. She was provided with two-furnace Scotch boilers and the Ellis and Eaves system of induced draft, which we were informed was very largely used on Lake vessels. For lubricating purposes grease, or "dope," as it is called here, was used everywhere about the engine except for the crank pins. As all large vessels on the Lakes are provided with double bottoms or ballast tanks, there was quite an elaborate system of piping for pumping out the various compartments, but everything else connected with the machinery outfit was as simple as it is possible to make it. One very good feature about the machinery was the gauge glasses for the boilers, which were so connected up that they were in plain sight in the upper engine room, so that the feed water could be regulated by the oiler on watch without his leaving the engine

room. The ship was provided with an electric-light plant and all the other up-to-date equipments of a first-class vessel.

One feature which would cause considerable envy among steamship officers on the coast was the large and luxuriously fitted quarters provided for the captain and chief engineer. An admiral of a fleet could have nothing better, so far as comfort is concerned.

It would interest deck officers of salt-water ships very much to see the masterly manner in which a 450-foot steamer is handled in a narrow thoroughfare such as the Milwaukee river. This stream is in many places less than 250 feet in width, yet one of these large steamers will start up to its dock, a mile or so up the river, as unconcernedly as if steaming out into the open lake. To add further to the difficulties of navigation there is a bridge about every 200 yards. Coming down the river the steamer will be towed the entire distance stern first, by two tugs, one at the stern and the other at the bow. As nearly all of the principal lake harbors consist of narrow rivers through the heart of the city this towing stern first is a very common thing, in fact so much so that many of the steamers are fitted with chain bridles at the bow and stern for the convenience of tug boats.

In conclusion the writer desires to state that many of the observations noted herein will, no doubt, seem very commonplace to those familiar with Lake navigation, but they are such as would, in his opinion, strike the average person brought up on the sea coast as being of interest on account of the contrast with similar conditions in ocean and coast navigation.

Congressional Aid in the Shipping Question.

Several shipping bills have been introduced in the present congress having as their object to relieve the depressing condition of our deep-sea shipping, yet it is probable that such legislation will be deferred until the report is received of the national committee recommended by President Roosevelt in his annual message. Following the president's plan a bill was introduced in the House of Representatives by Mr. Gardner, of Massachusetts, providing that such a commission be appointed. The bill is as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That a commission is hereby created, to be called "The Merchant Marine Commission," to be composed as follows: the Secretary of the Navy, the Postmaster-General, the Secretary of Commerce and Labor, the chairman of the Committee on Commerce of the Senate, the chairman of the Committee on the Merchant Marine and Fisheries of the House of Representatives, three members of the Senate, to be appointed by the presiding officer thereof, and three members of the House of Representatives, to be appointed by the speaker: *Provided,* That at least two of the said members of the Senate and two of the said members of the House of Representatives shall be members of the minority party.

SEC. 2. That it shall be the duty of this commission to investigate and to report to the Congress at its next session what legislation is desirable for the development of the American merchant marine and American commerce, and incidentally for a national ocean-mail service of adequate auxiliary naval cruisers and naval reserves.

SEC. 3. That the commission shall give reasonable time for hearings, if deemed necessary, and if necessary it may appoint a subcommission or subcommissions of its own members to make investigation in any part of the United States, and it shall be allowed actual necessary expenses for the same. It shall have the authority to send for persons and papers and to administer oaths and affirmations. All necessary expenses, including clerks, stenographers, messengers, rent for place of meeting, and printing and stationery, shall be paid from any money in the treasury not otherwise appropriated; however, not to exceed fifty thousand dollars for expenditures under this section.

SEC. 4. That any vacancies occurring in the commission, by reason of death, disability, or from any other cause, shall be filled by appointment by the officer and in the same manner as was the member whose retirement from the commission creates the vacancy.

The bill was referred to the Committee on the Merchant Marine and Fisheries, and on January 14 a public hearing before the committee was given to a number of shipowners and shipbuilders.

Admiral Francis T. Bowles, now president of the Fore River Ship and Engine Company, stated that there was at present no chance for American shipyards to build steamers for the foreign trade; that their work was confined to ships for the Boston Steamship and the Boston Towboat Companies, said that representative merchants and public men would be actuated by no interest except that of patriotism, included on the commission.

Speaking for the shipowners, Alfred Windsor, president of the Boston Steamship and the Boston Towboat Companies, said that subsidies granted to foreign vessels had driven them off the Atlantic ocean and they had transferred their ships to the Pacific, only to find that there they must compete with Japanese and English subsidies. He did not mind losing money for a year or two, he said, to build up a business, but the situation had now come to such a point that the American ships would either have to go out of commission or be transferred to foreign flags.

C. B. Orcutt, president of the Newport News Shipbuilding Company, said: "If anything is to be done it must be done quickly. There are many more shipyards than the business warrants, and there are no contracts in sight. If you are going to allow the shipyards to go into the hands of receivers, when you want to build ships there will be no yards in which to construct them."

Edwin S. Cramp, vice-president of William Cramp and Sons Ship and Engine Building Company, urged that a commission be appointed. He termed the merchant marine a "kindergarten for the United States Navy."

A. R. Smith, superintendent of the Maritime Association of New York, said his association was unanimous for the adoption of the bill, and presented resolutions to this effect adopted by the directors. Americans, he said, can invest in foreign vessels and earn a fair return for their money; if investment is made in American ships there is no return. A subsidy by the government would operate to the benefit not only of owners of vessels, but to the advantage of laborers and mechanics in the shipyards, because vessels would be built to compete for the world's trade.

Samuel S. Sewall, of Bath, Me., spoke of the industry which had been handed down to him through his father from his grandfather. His family were the largest owners of American sailing vessels. "I don't expect to leave the business to my son," he said earnestly, "for as things are going now there will be no business to leave." His firm built its own ships, but a year ago it launched its last ship, which was for the coastwise trade. The yards were now shut down and there was no prospect of opening them, as the income from American ships amounted to about the same as that from government bonds.

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THE recent address of the president of the American Society of Mechanical Engineers, as well as the not infrequent papers read before other engineering societies, dealing with educational subjects, show the deep interest which practical engineers feel in the matter of technical and engineering education. The time when the graduate of the technical school was without standing in the field of engineering practice is gone. Those who are in charge of the organization of industrial and engineering enterprises have found that the technical graduate is of definite economic value, and that the possibilities in the proper use of such a man are too great to be safely ignored. To gain the best results from such material, however, there must be a clear understanding of the true function of the technical school, and the graduates must not be expected to exhibit capacity and training which the school cannot be fairly called upon to give them, or at least the lack of such capacity or training should not be laid up against the school.

Broadly speaking, it is the function of the school to supply an opportunity, and to measure the extent to which the student avails himself thereof, certifying by a diploma to those who have, to a satisfactory degree, measured up the opportunities offered. The school cannot supply brains, or industry, or ambition, or other qualities essential to success, nor can it force the student to learn if he does not so choose. It should, however, and does, refuse to certify to the man in cases which fall below the standard assigned.

It is the further duty of the school in selecting among the wide range of activities which enter into the engineer's profession, to take those subjects which are fundamental and common to the profession at large, and, furthermore, to give primarily such instruction and training as the student cannot well obtain in the field of actual practice, or the attainment of which could only be achieved at the expense of a disproportionate effort. The possession of a diploma from a technical school means primarily, therefore, that the holder has had certain opportunities for becoming acquainted with the fundamental principles of engineering and with their application to various problems of a broad and representative character; and, furthermore, that he has availed himself satisfactorily of these opportunities and has therefore laid the foundation for success as an engineer. The latter, however, will require in addition years of experience with practical engineering and business life, contact with men and affairs, and a just balance of mind under control of good common sense. The recent graduate must not be assumed, by that fact alone, to be a man of affairs, a financier, a capable organizer and administrator of business ventures, a close estimator of production costs, an adept at handling labor and dealing with the many perplexing questions which the personnel of a large enterprise may involve, nor in general can he be safely assumed to have in an marked degree those qualities which are usually the results of actual experience with engineering and business life.

On the other hand, he may fairly be assumed to know how to do all sorts of things connected with the routine computations and determinations involved in engineering practice. He may be fairly assumed to know how to go to work to study new problems, and how to undertake to find out the unknown regarding questions which may arise in his daily work. The capacity for study, for grappling intelligently with the unknown, a capacity which every technical graduate should possess in some measure, is, perhaps, one of the most valuable

results which may be expected from technical training. In this same line the technical graduate may be fairly assumed to have capacity for studying new surroundings, for meeting new conditions, and for absorbing the essential features of new situations more rapidly and thoroughly than could be expected from the same individual without the advantages of such training.

In a general way most engineering work consists in determining the answers to two sets of questions: *what* and *how*—what shall be done and how shall we do it. As a rule the former questions require more of judgment and experience for their consideration, involving as they commonly do matters of policy and the weighing of opposing considerations, while in detail the latter questions more commonly involve simple engineering principles with a smaller element of experience and judgment. The latter elements are, for example, required in the determination of what combination of boilers, engines, and electric machinery will best fulfill the conditions for a given central-station power plant. Once the "what" is determined, the "how" of the design and installation is often a relatively simple and routine matter. While questions of the latter character often involve elements requiring broad experience and mature judgment, met in a general way, past experience can be more easily and directly applied to such problems, and the recent graduate can as a rule be more profitably employed in the early stages of his experience in connection with questions relating to the "how" rather than the "what."

The present status of the technical graduate shows that, in the opinion of those best fitted to know by direct use, the average man does gain in capacity for usefulness in engineering work by following a regular course of technical instruction, and any industrial undertaking in which the maximum possibilities of the present age are to be fully developed and utilized must recognize this fact. There may be exceptions to the broad rule. Some men might have their capacity for usefulness decreased rather than increased. Genius knows no law or limitation, and will assert itself quite independently of opportunities which the average man may well employ. The fact still remains, however, that the average individual, for whom courses of instruction have to be arranged, will profit by using opportunities which may be quite needless for the rare genius.

As to the reverse question—how well the technical schools are living up to their duties and opportunities—there is, perhaps, much to be said both in commendation and in kindly criticism. These remarks may, however, be reserved for a later opportunity.

COMPARISONS of American and foreign shipyards, which have regularly appeared in print for years past, have too often been inspired by a desire to belittle one or the other class of yards. This country long ago emerged from the experimental state in iron shipbuilding and established the fact that as fine ships can be built in this country as in foreign yards. However, it is always possible to improve, and by studying in detail the different elements which enter into the construction of ships, it will surely be possible to ascertain in what points construction may be cheapened. While this, of course, has been going on in all our shipyards and is the general manager's duty, yet we believe that much remains to be accomplished before our steel construction may be brought down to a cost comparable with other structural steel work. In busy times, getting out the work requires the attention of the entire force, while now in the dull present season the subject of economy may be more carefully considered. It is with this purpose in view that we have arranged for a series of articles on "Shipyard Economies," the second of which appears in the present number of MARINE ENGINEERING. With some notable exceptions, all of our plants are the growth of many years, and any conclusions as to where economies may be gained depend upon the lay-out of the plant as well as local conditions. Those elements, however, which are general to all plants are organization and labor. The difference in wages is responsible for most of the difference in cost between American- and foreign-built ships; the wages paid in our shipyards are practically the same, class for class, as elsewhere in the country; in the other iron manufacturing industries we have no trouble to compete with the foreign market; then why is it that in shipbuilding we cannot compete on the same lines? To anyone familiar with American yards, we will say that a large part of this is due to inefficient organization and administration. These questions in their different relations are dealt with in this article, the standpoint of the author being that of cheapening the cost wherever possible, without, of course, cutting down in any measure the output.

EVAPORATORS AND DISTILLERS.

BY G. W. BAIRD, CAPTAIN (FORMERLY CHIEF ENGINEER) U. S. N.

I have read with some interest an essay in your admirable journal under the above caption, by Mr. W. W. Edwards, and wish to state that the evaporator of the *Wilmington* is a No. 3 type B Baird machine; it is horizontal, with U-tubes, and unlike the (type C) machine shown in the illustration given by Mr. Edwards. It was not built by Mr. Davidson. The "distiller" he describes is also a Baird machine, though he does not name it.

My experiments in distilling from sea water began in 1862. The *Journal* of the Franklin Institute for January, 1872, gave a detailed illustrated paper upon the subject, clearly explaining the chemical and physical processes essential to the production of potable water by distillation from sea water.

The first so-called "distillers" on board ships having jet condensers, produced water which was potable after about a week's exposure in tanks. The same distillers, when used in ships having surface condensers, produced water which was not potable inside of two weeks. Such was the condition of our water-making when I took up the subject. Agitation of the water in the tanks, projecting the water in a spray, blowing air into the water in the tanks, and finally mixing air with the steam previous to its condensation, were tried *seriatim*. For the details of these experiments I beg to invite attention to the pages of the *Journal* of the Franklin Institute. The process which was the most effective, the quickest in its action, and the cheapest of mechanical construction was the mixing of the steam and air by means of the air injector known as the aërator, which I first patented in 1869. My evaporator, a fireless boiler, is a later invention. I made my first experiments on the evaporator in 1871, and took out my first patent in 1884. I had it ready for use as soon as the state of the art was ready to use it. The evaporator furnishes steam from sea water.

Sea water is essentially a chlorinated alkaline mineral water, the solid contents of which are chiefly sodic, calcic, magnesic, and potassic chlorides and alkalies, which, after distillation, remain behind as a residum and may be blown out of the boiler. The organic matter in sea water is limited.

The water in a steam boiler, especially when it is used in connection with a surface condenser, is very different. It contains great quantities of organic matter, which are uniformly accumulating all the time the engine is moving. The office of the aërator is to oxidize this offensive organic matter more than to give the water a sharp taste.

The aërator, however, is not nearly so effective unless used in connection with an animal charcoal filter—a filter which will not remove mud nearly so well as a quartz or a sand filter, but which arrests oxidized matter. This is why the Baird distiller was such a marked success in the period just preceding the evaporator, and if it was effective under such adverse circumstances, its use is warranted now. Mr. Edwards shows, in his Fig. 1, a Baird evaporator, distiller, filter, trap, etc., complete.

The taste of water freshly distilled from a steam boiler is oleaginous and "smoky," but from clean sea water, as used in an evaporator, it is only "smoky." A glass of water drawn from the distiller, when the aërator is in operation, will be so full of air that the bubbles will adhere to the sides of the glass as in a glass of soda water; the water is thus overcharged with air. The amount of oxidized matter precipitated and found in the bottom of the ship's tanks is an indication of the impurities which have come over from the boiler or evaporator. There are some volatile impurities in the sea water which come over with the steam, but these are exceptional. In the Bay of Callao the sea water is impregnated with sulphuretted hydrogen. In that bay we found it necessary to expel the gas from the water in a large boiler and draw upon this large boiler for the feed water for the distilling boiler.

Many years ago, before the days of using petroleum products for cylinder oil, the crew of the *Monocacy* was attacked with diarrhœa; not a man escaped. It was quickly traced to the potable water, which had been distilled from the main boilers while castor oil had been used in the steam cylinder of the main engine and had found its way into the boilers. There was not the slightest taste of castor oil in the water. The active principle of the castor oil seems, therefore, to be tasteless, and it is strange that chemists have not resorted to this simple method of separating it.

Freshly distilled water is, however, a strongly solvent fluid; it has never been known to injure an animal; it is an active agent in flushing out the kidneys, and will carry off impurities more rapidly that any other kind of water, excepting Poland water and some of the waters of Hot Springs, Arkansas. Both of these waters have the "smoky" taste peculiar to freshly distilled water, and probably much of it has been vaporized and condensed in the earth just previous to its exit. Freshly distilled water soon dissolves the zinc from the surface of galvanized iron; it rapidly eats "pit holes" into the purest Banca tin; it dissolves copper, hot or cold, to a greater extent than any other known water. But it seems to lose this active property with age.

The rapid destruction by distilled water is, I believe, responsible for much of the "pitting" of boiler tubes, the destruction of condenser tubes and shells, wrought-iron shells of feed heaters, etc.

If we place brass tubes in the brass shell of a condenser the tubes will corrode. If we place copper tubes in the same shell then the shell will go. If we place copper tubes in a copper shell the tubes will go. But if we use a cast-iron shell with brass tubes for a condenser or a feed heater, we may be sure of much greater endurance. Since learning this (from experience) I have never used any but cast-iron shells and brass tubes in my distillers, unless otherwise specified, and my experience in business, though limited, taught the futility of offering any extended advice to the men who make specifications.

The distiller has done much for the mariner and much for the shipbuilder. In the matter of weight alone a revolution has been wrought. A ton of coal will put from seven to eight tons of distilled water into a ship's tanks. The entire weight of the distilling

plant in the new ship is less than the empty tanks in one of the old sailing ships of the same displacements. Instead of carrying 150 days' supply of water a ship now has stowage for but 10 days' supply. Instead of an allowance of a gallon a day per capita there is now a liberal supply of water even for bathing. A bath tub was not known in a ship until steam and the distilling apparatus had come to stay.

It has done as much for hygiene. It is well known that a *change of water* frequently produces sickness. While a man may become immune to the typhoid bacteria, he is still susceptible to the *comma bacillus* which produces cholera. While he may be immune to yellow fever, he will readily respond to the active agents of zymotic diseases. The modern, educated physician now advises against taking a drink of water from a spring in the country; he advises his patient and his friend against any change of water excepting that which has been sterilized. It is safe to drink malt liquors (or water which has been boiled) when traveling. About twenty-five years ago epidemic Asiatic cholera appeared on board every ship in the harbor of Hong Kong excepting the United States war vessels, and on board these ships distilled water alone was drunk. Distilled water is the only water a sailor can get which is uniform in quality. Since its introduction in the navy diarrhœa and all other so-called zymotic diseases have diminished more than fifty per cent.

The great run of the battleship *Oregon* from Puget sound to Jupiter inlet, during the war with Spain, was greatly facilitated by the copious supply of fresh water for her boilers, which was "made up" by the Baird evaporators on board that fine vessel.

Editor MARINE ENGINEERING:

Referring to the criticism of Capt. G. W. Baird, U. S. N., of my article on "Evaporators and Distillers," I beg to advise that at no point in this article did I state that the *Wilmington's* evaporators were or were not Davidson machines. The blue prints and drawings, from which the illustrations Figs. 1 to 5 inclusive and Fig. 7 were made, were all furnished by the Davidson Company. In regard to the utility of the aërator I would state that my experience, extending over some years both in the navy and out of it, confirms my opinion that it is useless. I *know* that I have disconnected it and I *know* that no evil results came therefrom. The logic of fact is, to me, convincing.

WALTER W. EDWARDS.

Tenth Annual Sportsmen's Show.

The tenth annual Sportsmen's Show will be held at Madison Square Garden, New York, N. Y., from February 19 to March 5 inclusive. From present indications it promises to be most successful in point of artistic arrangement, number and class of exhibitors, and because of the interesting series of tournaments and exhibitions to be held. So great has been the demand for space that the frontage on the artificial lake has been given up entirely to marine exhibits. The tournament in fly casting has become so popular that a special tank has been built for this competition above the lake on a level with the galleries.

Typical exhibits will come from the wilds of Canada and the Rockies, and the hunting grounds of Maine, the Adirondacks, and Virginia. Various competitions will be held between the guides of the different sections, such as in saddling and off-saddling packing horses. A fine live-animal exhibit has been arranged for. The programme of water sports now being arranged will embrace canoe tilting, canoe racing, and several novelties such as push ball, which consists of canoeists endeavoring to push an immense floating leather ball 7 feet in diameter. It is promised that the marine exhibit will be specially interesting.

ENGINEERING SPECIALTIES.

New Boat-Launching Device.

While modern passenger steamers are being built of increasing dimension, and are fitted with innumerable auxiliaries in engine room and on deck for the efficient running and handling of a ship, comparatively little attention has been given to the arrangement for carrying lifeboats and adequate devices for launching them. The modern lifeboat with air tanks, cork fenders, and self-bailing apparatus, is all that can be desired as a life-saving appliance if it could but be successfully launched. The lifeboat is set in a cradle secured by lashings or grips and covered over by a canvas, all of which means that valuable time is lost when it becomes necessary to put the boat overboard; also if the ship has a bad list, as the result of an accident, one-half of the boats on the upside are made useless.

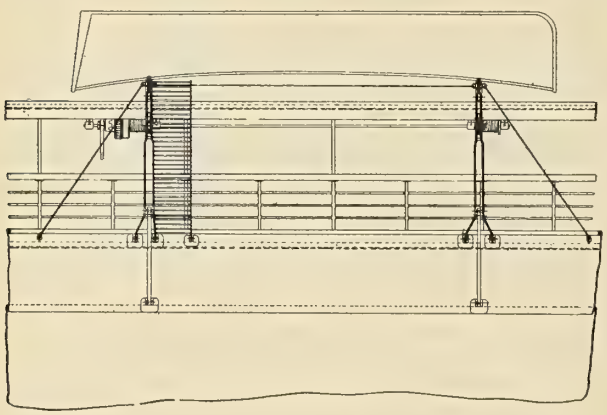
The Powers system of carrying and launching lifeboats is designed to successfully meet these severe requirements, and is adapted to existing types of ships and boats.

In this device the launching apparatus proper consists of a standing part, and a rocking arm, which, in the stowed position, extend inboard from the ship's side; this arm forming the support for the boat, which is carried bottom up on top of it. In this position the boat is inside the line of the ship's side, and, being on top of the davits, is to all intents and purposes outside them.

The boats when stowed are held in place by lugs on the rocking arm, which fit inside the gunwales; also by the hoisting lines wound on the drums. It will be noticed that these lines are led over the sheaves in such a way as to first bind the boat to the rocking arm, then bind the rocking arm to the standing part, and lastly, bind the standing part firmly against the ship's side. In this manner the boats are more securely held in place than at present, and the lashings are reduced to the minimum. By carrying the boats upside down, there are no covers to be removed; by holding the boats in place with the hoisting lines, all lashings are dispensed with, and by carrying the boats on top of the rocking arm no chocks are required.

The motive force used to operate this device is electricity. An electric motor, located in a convenient place, is connected by gearing to a worm shaft, which engages a worm gear, mounted loosely upon a long shaft located under the shade deck. This worm gear is arranged to be connected with this shaft by a clutch when desired.

Upon this shaft are two drums; one opposite each davit, upon which the hoisting lines are wound. Directly opposite each davit, on the under side of the deck, is a rack, driven by gearing connected to the main shaft at the side of each drum. These gears are so proportioned to the circumference of the drum and the position of the rack that the rack is forced to move at relatively the same speed as the lines upon the drums. It will be seen then that when the current is turned on in the proper direction that the main shaft will be revolved by the worm gearing unwinding the lines from the drums; at the same time the rack gears are driven outboard against the davits at relatively the same speed as the lines are being unwound, forcing the davits away from the ship's side. In this part of the operation the boat and davit are as securely held in place as when fully stowed; any movement being opposed by the outboard thrust of the rack and the inboard pull of the lines. When the davits have been forced outboard sufficiently



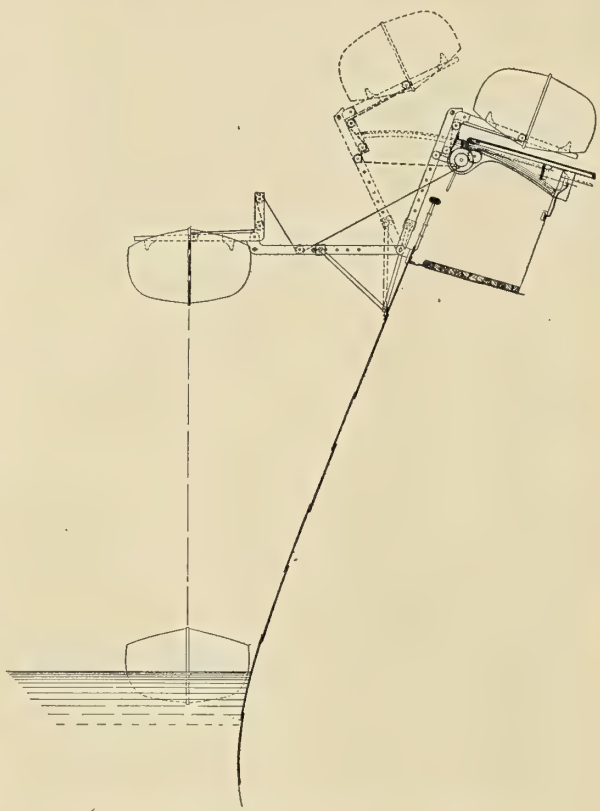
LIFEBOAT AND LAUNCHING DEVICE STOWED ON BOARD.

their weight causes them to continue moving outward and downward until the standing part of the davit comes to rest by reason of the strut guides coming in contact with toggle bolts placed in holes in the standing part. Then the rocking arm turns on its pivot and the boat is turned right side up ready to receive the passengers and crew. Afterward it is lowered clear of the davits into the water, the lines being cast off by any good form of releasing hook desired.

This entire operation is positive regardless of the list of the ship, and by placing the toggle bolts in the proper holes the davits are stopped parallel to the water. The only movement of the davits is outboard or inboard, as the case requires; the davits being permanently guyed in a fore and aft direction. By this system of operation the launching may be controlled by the officer in charge at the boat, or by the officer on the bridge, where there would be a central boat station.

On the after davit is fastened a light metal grating forming a gangway from the ship to the boat when the latter is in the launching position. This gangway is only wide enough to admit one person to pass at a time and is protected on either side by lifelines. One of the main reasons for placing the boat upside down is now evident, *i.e.*, to prevent anyone from getting in before the boat is ready for them. The officer taking his station at the narrow gangway is in a position to see that the boat is properly loaded and manned, and effectually stop any tendency to scrambling and overloading. In no other system has any attempt been made to control a panic-stricken crowd. In this system the boats are always beyond the reach of the crowd, and entirely under the control of the officers.

The boat, when launched, is at a sufficient distance from the ship's side to prevent collision therewith, and to allow the oars to be used the instant the boat touches the water. As both hoisting lines are wound upon drums of the same size, fastened to the same shaft, both ends of the boat will be lowered at the same time. The lines are rove single, without slack at any time, so are not liable to foul. A suitable brake is fitted to the



LAUNCHING LIFEBOAT FROM THE SIDE OF A LISTED SHIP.

shaft for controlling the launching by hand, as it is only necessary to check the speed of the boat while lowering.

As this apparatus does not require any handling of the boats no deck space is required, except what the boats occupy, allowing the boats to be carried nearer together, thus giving increased deck room or allowing more boats to be carried. The weight of the davits proper would be about half that of ordinary davits, the cost being about the same. The motor and gearing, with necessary wiring, would be an additional expense, which may be little or much according to the extent to which the system is elaborated. The use of this apparatus is not restricted to any particular type of vessel, neither is its location restricted.

This system is the invention of Wilbur F. Powers, 318 North Fourth street, Camden, N. J.

The Rockwell Rotary Melting Furnace.

An entirely new type of metal melting furnace has just been brought out which possesses many distinct advantages in economy and ease of operation. One of its principal features is the utilization of the heat of the spent gases of combustion. This is accomplished by means of the two chambers, which are independent but communicate with each other through their necks. One of the chambers is always in the act of melting, the other receiving the spent gases which give up their heat into the fresh charge of metal in this latter chamber. As soon as one melt is poured and the chamber recharged the fire is reversed. In this manner the melting is practically continuous. It is quite reasonable that it should result in a saving of fuel, a saving of time, and a protection of the metal. While the operation as a whole is rapid it will be seen that the metal is always heated up gradually; also that the flame never enters a cold chamber.

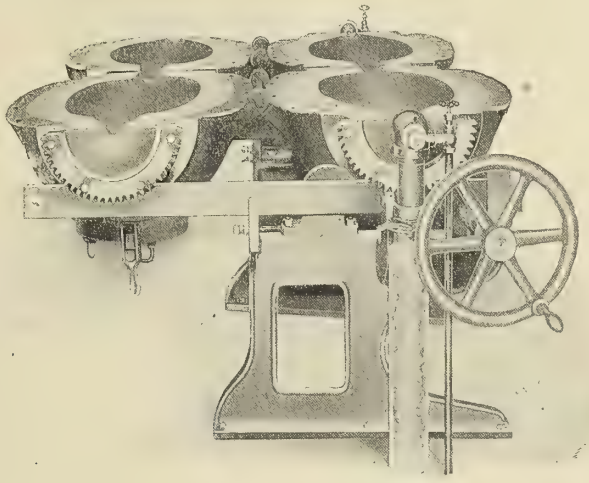
Another feature is the entire absence of crucibles. Nor are any tiles or fire brick used in lining. The lining is an inexpensive material rammed into the furnace shell in bulk and burned hard and refractory in place.

Another feature is the ability to melt two different metals at the same time. While the normal operation is that of melt and reverse, it is also entirely practicable to operate both burners and melt in both chambers at the same time. Where different mixtures are required this would be very convenient. Or the same metal could be melted at the same time in both chambers if an unusually large casting was wanted.

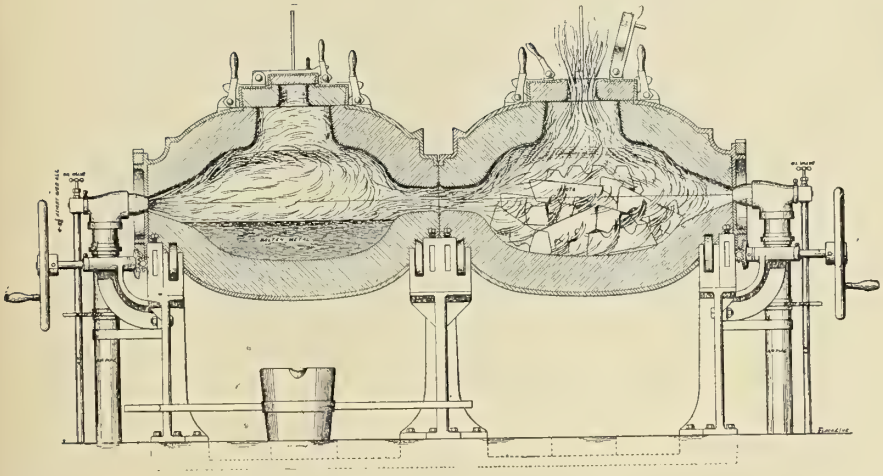
Other features are: large output as to floor space required, general comfort and cleanliness, no complicated parts or expensive repairs. Oil or gas is used as fuel and the air for combustion is supplied from an ordinary fan at about 12 ounces pressure.

The furnace is sold in four standard sizes ranging in capacity from 350 to 3,000 pounds each chamber.

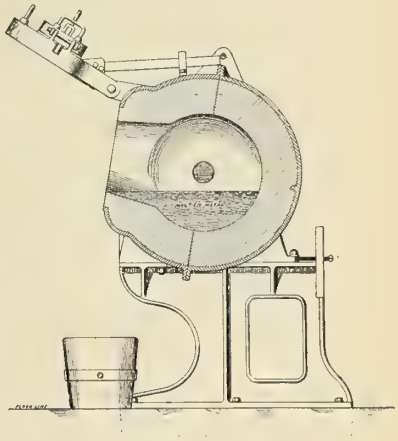
As the name indicates the furnace is manufactured by the Rockwell Engineering Company, 26 Cortlandt street, New York, N. Y.



END VIEW OF FURNACES, OPEN.



SECTIONAL VIEW OF FURNACES SHOWING METHOD OF MELTING AND HEATING METAL.



POURING THE METAL.

Broken Taps Remover.

The device illustrated in the cut below is adapted to engage and remove pieces of taps which have been broken off in a tapped hole. It consists of a cylindrical holder, whose diameter is substantially equal to the diameter of the tapped hole and which is provided with a square section at one end to receive a wrench. This holder has longitudinal grooves corresponding with the longitudinal grooves in the tap, said grooves being for the purpose of receiving the sliding-tap engaging bars. These bars are fixed at their upper ends in a sliding collar, by which they are moved lengthwise of the cylindrical holder. A loose sleeve is held to slide on the holder, and when the remover is applied to a broken tap the sleeve is slid down close to the work, thus supporting and holding the tap engaging bars in their respective grooves at the point where the strain is applied. This is a simple, strong, quick, and sure device for the removal of pieces of taps broken off in a tapped hole. It engages the broken piece of tap, unscrewing and removing it from the tapped hole without damage to the work. It is always ready for instant use, and saves time and expense.

DEVICE FOR REMOVING BROKEN TAPS.

The outfit consists of a set of six sizes for standard taps, from 1-4 inch to 5-8 inch, and is manufactured by the Atlas Machine Company, Providence, R. I.

Electric Trolley Hoist.

Electric hoists are now in operation in some of the largest manufacturing plants in this country, and are economizing labor and increasing outputs to a wonderful extent.

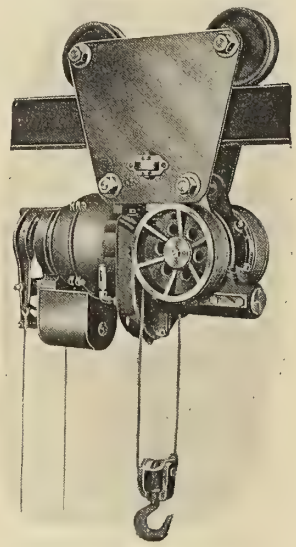
In many machine shops of the usual design, a middle aisle spanned by traveling cranes and side aisles over which galleries are located, the space under the galleries is not fully utilized, because a good power hoist to carry the work to and from the tools has not been obtainable. In most foundries the majority of loads to be lifted weigh less than four tons, and the operation of handling moulds, ladles, etc., calls for fine adjustment and control of the hoisting apparatus. In shipyards and large manufacturing plants where successive operations are conducted in separate buildings, there are many light loads which it is necessary to transfer at high speeds.

These are a few of the conditions which make the type W hoist, built by the Sprague Electric Company, a valuable labor-saving device, as it is specially suited to this class of work.

The cage-controlled electric traveling crane is a highly developed piece of apparatus, and for continuous work where heavy loads are to be lifted and carried considerable distances, it fully meets existing requirements. Extremely delicate movements are, however, difficult or impossible, as the operator in the cage must be signaled from the floor for every lifting or lowering movement until the load safely clears the ground. The load may be a casting weighing a ton or less, which is to be lifted from the floor to a machine tool a few feet away. The entire operation, including bringing the crane to the work, will take considerable time, and during that time other portions of the works are probably waiting for that crane and its operator. A few type W hoists could be used at several points at once, and if controlled from directly beside the load the adjustment can be as delicate as desired.

Air hoists, hand chain blocks, and steam cranes are found in great profusion in foundries, because they are made in small units and can be controlled from near the load.

Hand chain blocks are slow, and air hoists require the installation of an expensive compressor and reservoir



ELECTRIC TROLLEY HOIST.

system, and are limited in travel by the amount of hose it is possible for them to drag along without rupture. The direct-acting, cylinder-type air hoist is limited in height of lift, and if a vertical cylinder is used more headroom is occupied by the cylinder than the available lift. The air-motor hoist is an extravagant power consumer, and the power lost in leakages in the hose and piping of either type, with all hoists shut off, is often as much as would be required to operate an equivalent system of electric hoists.

The electric hoist is claimed to present every advantage of high power per space and weight, efficiency, durability, ease of control, and range of transmission, and nearly all factories are now equipped for electric power. A successful electric hoist, however, must be practically indestructible, because it is handled not by a skilled operator but by the ordinary factory help. It should be weather-proof and of extremely light weight, as it is often necessary to use it outdoors or to install it on runways attached to buildings already erected, and if the weight of the hoist itself is excessive this often becomes difficult.

The hoist herewith described and illustrated was designed with a thorough knowledge of the above-men-

tioned conditions. It consists of three distinct parts: the hoist proper, including the motor and gearing; the controller; the trolley carriage.

The hoist proper consists of a weather-proof Lundell round type series wound motor, the necessary speed reduction being obtained by a spur and a worm gear. The drums are mounted on the worm-wheel shaft, one on either side of the wheel, and when chain hoists are ordered sprocket wheels are substituted for the drums.

The gearing and one motor bearing is enclosed in an oil-tight gear case; this case being bolted to the end of the motor and partly filled with grease or oil. The rotation of the gears automatically oils all wearing parts.

The use of a combined spur and worm gear makes it easy to obtain automatic lubrication without danger of oil running back into the motor, as the shaft of the motor is placed above the oil level, and also allows a high ratio of speed reduction to be obtained in small space and for low weight of gearing.

Only the very highest grade of material enters into the construction of this apparatus. The motor has a steel frame; the worm is steel case hardened and ground, the thrust being taken by hardened steel ball or roller bearings, and the worm wheel is made of a special grade of bronze. All gears are cut, and all parts called upon to bear the strain of the load are designed with a large factor of safety.

The rope-operated controller is mounted on the hoist, hoist carriage, or bridge, travels with the load, and is operated by hanging cords or ropes, thus doing away with the necessity of having a special crane operator. The type S controller used on this hoist consists of a cylindrical reversing switch provided in the larger sizes with magnetic blowout. No resistance is used with this controller, the current being thrown directly on to the armature. All wearing parts are renewable. This is the strongest and most durable controller it is possible to make.

The brake is operated mechanically by a cam attached to the controller shaft. The brake arms are held together by a spring, and with the controller in the off position the brake is set. When the controller arm is pulled down by the operating cord, the cam on the controller shaft engages two studs attached to the brake levers, and separates the brake arms, thus releasing the brake. The action is positive, and the only wearing parts are the brake shoes which are made of wood and easily and quickly renewable. A limit switch is provided which automatically prevents over-hoisting.

The general offices of the Sprague Electric Company are at 527 West 34th street, New York, N. Y.

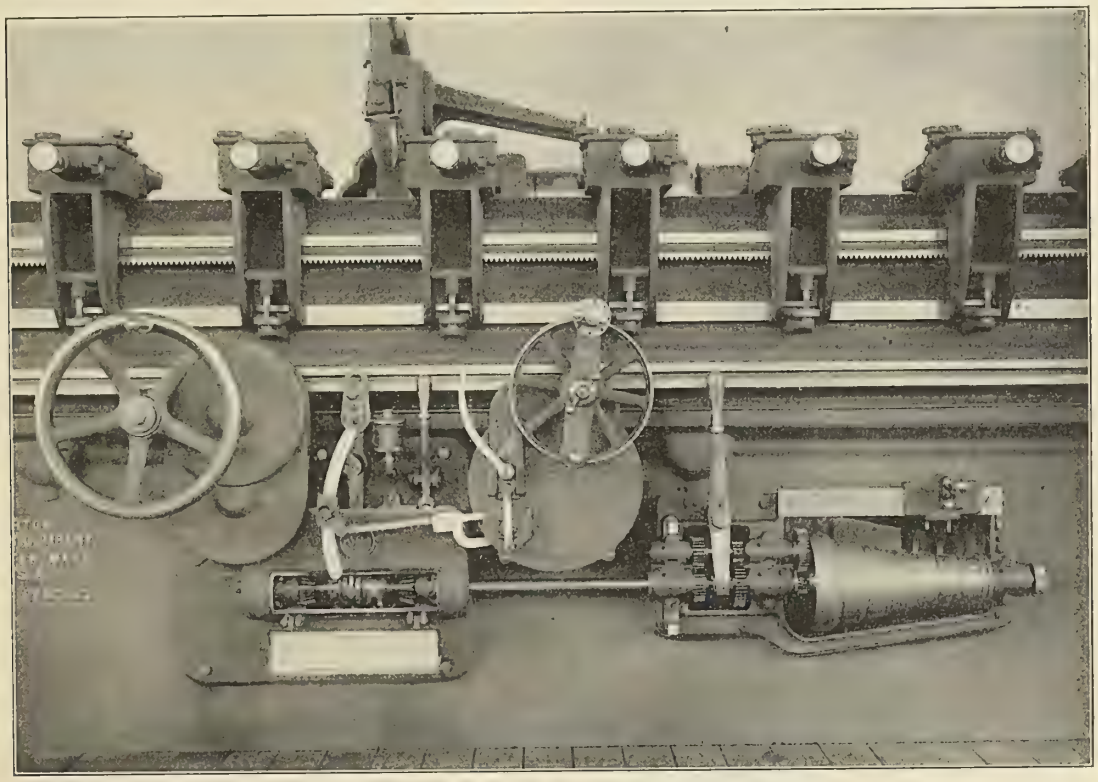


FIG. 1.—ENLARGED VIEW OF FRONT OF NEW CYLINDRICAL GRINDING MACHINE.

New Cylindrical Grinding Machine for Marine Work.

Within the last three years great strides have been made in the art of cylindrical grinding, until it is now wholly practical to finish, by grinding, work up to 14 feet in length and 7,000 pounds in weight. It is also practical to do this grinding at a large saving in cost over the old methods.

Machines such as here shown are now in use in some of the largest shipbuilding plants in Scotland, Ireland, and the United States.

Fig. 2 is a front view of the machine; the length over all is 22 feet; its weight is 22,000 pounds. The distance between centers is 14 feet, and the swing is 18 inches. The grinding wheel is 24 inches diameter, and the machine may be arranged to carry wheels up to 2 inches or to 4 inches thick, according to the class

of work to be done. For ordinary work a 10-horse-power motor is sufficient to drive the machine, while in some special cases motors of 15 horse power are fitted. The machine itself is designed to use a maximum load of 20 horse power.

Fig. 1 is an enlarged view of the mechanism shown at the front near the center of Fig. 2. The cover is removed to show the cone and gearing by which 14 changes of speed are obtained for the traversing work table; these changes can be made instantaneously without stopping work. The reversing clutch and gearing for transmitting the power to the traversing table, also

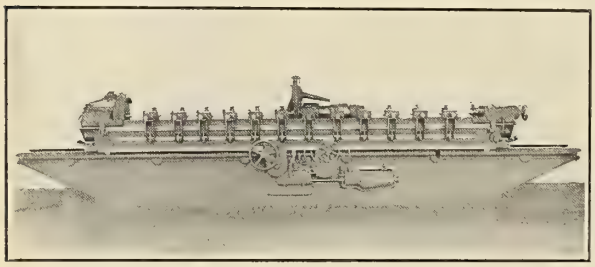


FIG. 2.—22-FOOT CYLINDRICAL GRINDING MACHINE FOR MARINE WORK.

the means for moving the table by hand, are mounted on a very rigid apron, near the left of the enlarged view, with the small cover turned down to show the reversing gears and clutch. The rear view of this apron with gearing swung forward and down will be seen in Fig. 3. This apron also contains the reversing lever

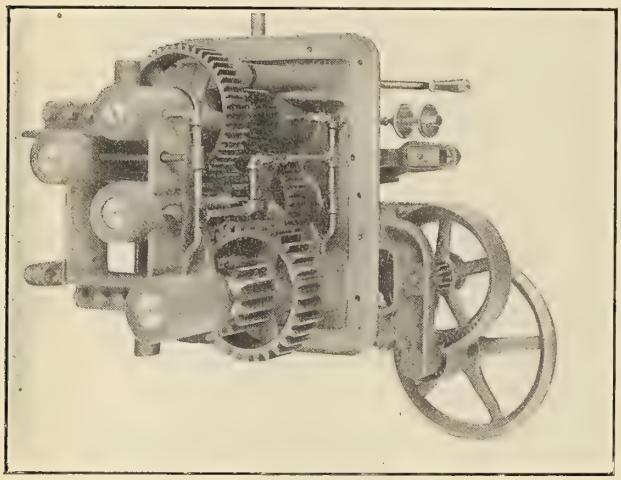


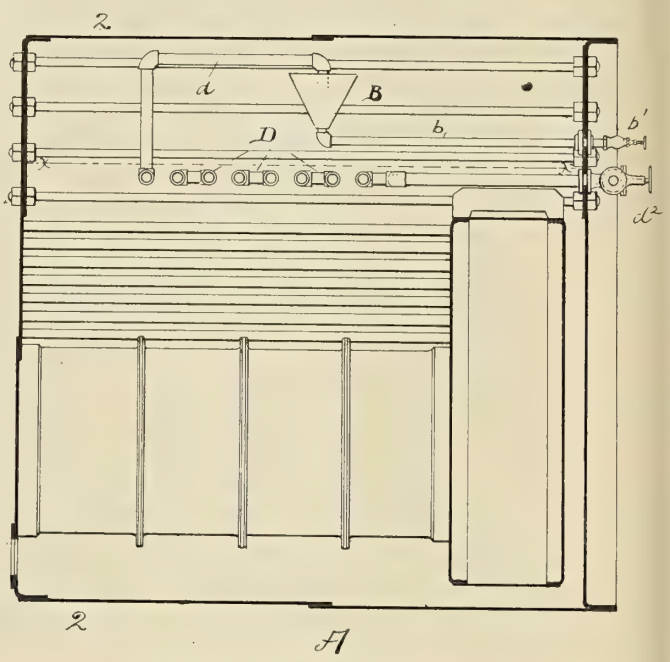
FIG. 3.—REAR VIEW OF APRON.

and lever for starting and stopping the table. The cross-feed mechanism for moving the grinding wheel to the work is shown at the center, between the table speed-cone frame and the apron. The feed is moved automatically or by hand, and has both fast and micrometer motion. The little dial with holes, shown at the top of the index wheel, is used in connection with the small crank and dial pin to obtain reductions in the diameter of work as small as one-quarter thousandth. The arc, shown on the front of the reversing lever, is used to vary the depth of cut of the grinding wheel when using the automatic feed.

The speed of revolution of the work is changed at the head stock by means of the lever and cone. The head and foot stocks are unusually massive and are moved by means of a crank rack and pinion. Some idea of the proportion of these heads may be obtained from the fact that the center holes are 3 inches diameter and the foot-stock spindle is 4 7-8 inches diameter.

The wheel spindle is massive, weighing, with its collars and pulley, 150 pounds; the wheel is guarded by a massive guard covering the wheel and confining the water. The water tank holds over a barrel of water; the pump is of large capacity, delivering 35 to 40 gallons per minute on the work. The form of machine and table is such that the water is cared for, and does not reach the operator or floor.

The machine will grind tapers up to 1 1-4 inch per foot; has massive steel-work drive to withstand hard usage, and is well designed throughout to serve the needs of a heavy marine workship. It is built by the Norton Grinding Company, Worcester, Mass.



SIMPLE FEED-WATER HEATER AND PURIFIER FOR MARINE BOILERS.

Feed-Water Heater and Purifier.

The many advantages resulting from heating the boiler feed water are now recognized, yet in marine work it is not the general practice to install a separate heater other than the hot well. The nearer the temperature of the feed approaches the temperature of the boiler water the less straining the shell is subjected to as a result of unequal temperature, and the longer will be the life of the boiler. Herewith is illustrated a simple device used extensively on the Lakes for not only heating but also for purifying the feed water.

In the Reynolds heater the feed water comes in circulation in the boiler at about the same temperature as the boiler. It, however, possesses the distinctive advantage of acting as a purifier and cleanser as well.

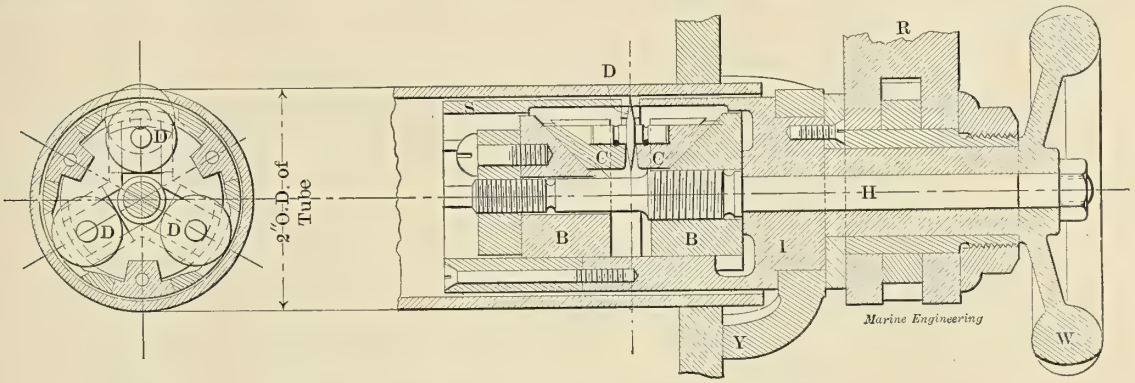
Much of the material held in suspension in the water is precipitated upon heating, and is carried off out of the boiler before it may deposit on the plates or tubes. The working of the heater and purifier will be readily seen by referring to the illustration.

The feed water passes through a blow-off valve d^2 and a check valve placed close to the boiler, into the heating coils *D*, which are placed just below the water level. In these coils the water is heated to practically the temperature of the boiler water, and then it passes through pipe *a* and is delivered into an open-top receiver *B*, supported in the steam space. The discharge pipe *b* extends out through the boiler, and is provided on the outside with a blow-off, b^1.

In operation, the water is forced through the pipe *D*, and heated nearly to the temperature of the boiler water, when most of the impurities are separated. The water discharging into *B* flows over the top, while the impurities settle in the bottom, and may be drawn off from the pipe *b* and blow-off cock. Also, such impurities as may have settled in pipe *D* may be blown out by opening the blow-off cock, d^2. This apparatus is made by Reynolds and Company, Perry-Payne Building, Cleveland, O.

worked by means of the shaft on right and left threads, so as to cause the blocks to approach or recede from each other. The shaft is made to revolve by means of an adjustment hand wheel, *W*. Beveled sliding blocks, *C, C,* which are dovetailed into the cylindrical blocks, carry the knife-edged roller disc cutters, *D, D, D*. A turn of the adjustment hand wheel serves to raise the discs into contact with the tube through slots made in the shell for that purpose, or to lower them as may be required. Cast with the shell is an extension or hub, on which is fitted a yoke, *Y*, as a bearing against the boiler, and also on this hub is fitted a ratchet crank, *R*.

The tool is inserted into the tube until the prongs of the yoke come in contact with the boiler head, and is then held firmly until the disc cutters are brought into contact with the tube, then a turn or two is made with the crank. The entire tool revolves except the yoke, as the crank is turned, care being taken to keep the cutters up against the tube by means of the adjustment hand wheel. Before inserting the tool into the tube a quantity of oil should be poured into the shell through the cutter slots, and it will then feed automatically as required to the cutters.



END AND SECTIONAL VIEWS OF A NEW BOILER-TUBE CUTTER.

New Boiler-Tube Cutter.

The New Century boiler-tube cutter is a tool designed to cut off boiler tubes of any size, when it is desired to take them out of any boiler for any cause, and also to cut off the ends of the tubes at the required length for beading. The tools are made in sizes to suit, and are adapted for use in any variety of boiler. Each tool has three or more specially tempered tool-steel, roller knife-edged disc cutters, mechanically adjusted by means of a hand screw, and operated by a ratchet crank. This tool is so constructed as to automatically oil the tube at the point of contact with the cutting edge of the discs. The cutter does not burr or expand the tube at the point where it is cut off or elsewhere, thus allowing the cutter to be taken out through the tube hole in the boiler head or sheet, and without injury to the boiler—which so often happens when tubes are removed in the ordinary way.

From the cut it will be seen that the working parts of the tool are enclosed in a cylindrical shell, *S*. Through the longitudinal center of this shell passes a shaft, *H*, with right and left threads. Around this shaft are two cylindrical blocks, *B, B,* fitting into the shell, and

Any tube may be cut off in from two to five minutes with this tool, and it is so simple to operate that any man with ordinary intelligence may use it. As a time- and labor-saving invention it will go a great ways in reducing the cost of cutting out old tubes from a boiler. It is the invention of Mr. J. S. Hill, chief engineer of the Interior Department, U. S. Government, and is made by the Kendrich Automatic Damper Regulator Company, Washington, D. C.

Vessels Lost and Condemned during 1903.—A statistical summary compiled by Lloyd's Register for the vessels of 100 tons and upward totally lost, condemned, etc., during the quarter ended June 30, 1903, shows that the total of all countries amounted to 135 of 105,968 gross tons. The greatest of the losers were, of course, Great Britain and her colonies, whose losses numbered 20 vessels of about 30,446 tons. Over half of these were wrecked, and the rest made up of 1 burned, 3 lost in collision, 1 foundered, and 1 missing. The next severest loser was Norway, followed by the United States and Holland.

THE DESIGN OF MARINE MACHINERY.

BY W. F. DURAND.

The Stephenson Link.

The variation of lead with linking up of the gear for both open- and crossed-rod types is thus clearly shown. It yet remains, however, to show the proper curvature of the link in order that such change may be equal at both ends of the stroke.

In Fig. 25 the gear is shown with the engine on the lower or out center, while the valve will be above or to the right of its mean position, and open by the amount of the lead as it may be determined. Suppose now that the eccentric rod QB is disconnected at Q and carried up to P, as shown by the dotted line PB. The link will then occupy the position AB_1, and at mid-gear the valve stem would be moved downward or to the left by a distance KH, thus decreasing the amount of opening by this distance. Again in Fig. 26 the gear is shown with the crank in the top or in center, while the valve will be below or to the left of its mean position, and open by the amount of the lead as it may be determined. Now, suppose again that the rod PB be disconnected at P and carried over to the position shown by QB_1. The link will then occupy the position AB_1, and at mid gear the valve stem will be moved upward or to the right by a distance HK. It is easily seen that with the construction as shown the distances HK in each diagram are the same.

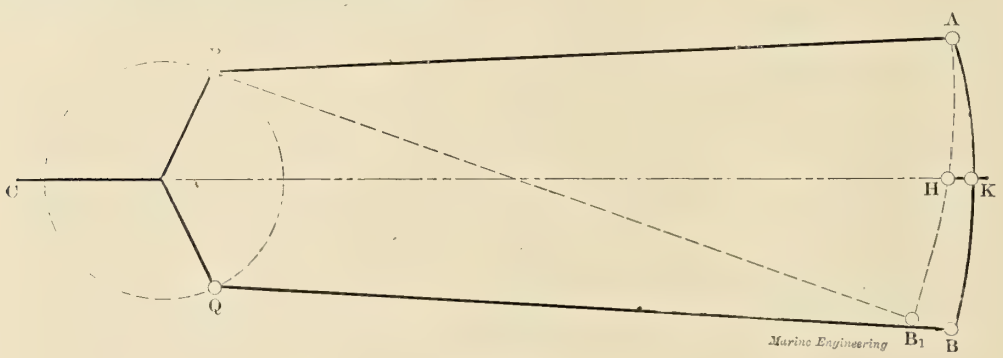


FIG. 25.

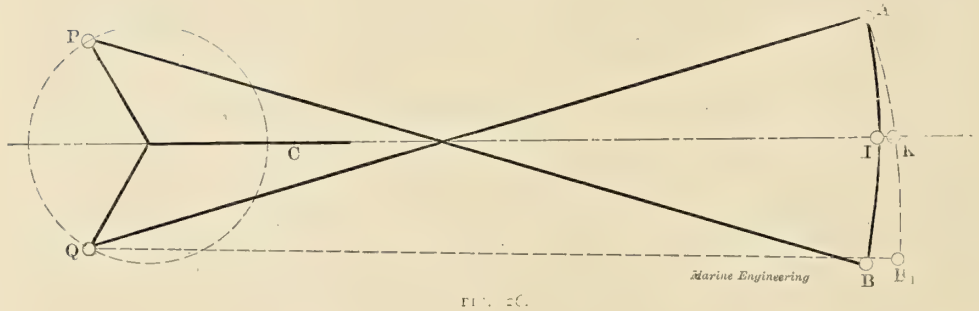


FIG. 26.

Now suppose in Fig. 25 the link is thrown into full gear. This means that the point A will be carried down about P as a center, and will therefore describe the arc of a circle with PA as radius and P as center. Suppose now that the radius of curvature of the link AB_1 is greater than PA; then when thrown into full gear the point A will lie to the right of the H, and the lead between mid and full gear will be cut down by an amount slightly less than HK. At the other end of the stroke, as shown in Fig. 26, suppose likewise the link moved down into full gear. This means that A will move downward, following the arc of a circle about Q as center and with QA as radius. Then if the radius of the link is greater than QA the point A will lie to the right of K, and the lead between mid and full gear will be cut down by an amount slightly greater than HK. Thus, with this value of the link curvature the variation between full and mid gear will be less than HK on the lower end of the stroke, and more than HK on the upper. Similarly it may be seen that if the radius of the link is

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* Continued from January number, page 40.

less than the eccentric rod the variation in the lead will be greater than *HK* on the lower end and less on the upper. It is thus clear than in order to have the variation of the lead the same at each end the radius of curvature of the link must equal the eccentric rod, and that under such condition the point *A* when linked up will coincide with *H* in Fig. 25 and with *K* in Fig. 26, and in each case the change in the lead will be measured by *HK*. In a precisely similar manner the same conclusion may be drawn for the crossed-rod type of gear.

We thus draw the important conclusion that for equal change of lead at each end of the stroke the radius of the link must equal the length of the eccentric rod.

[12] Design of Stephenson Link Gear.

(1) *General Considerations.* The information upon which the design of a Stephenson link is based usually provides the point of *cut-off, port opening* and *lead,* all under normal working conditions. Based on these items the construction of the Bilgram diagram, as explained in [5], may be most conveniently used to determine the simple eccentric which would realize the conditions desired. If, then, two eccentrics, *OA and OB,* Fig. 27, are laid off with throw and angular advance as determined, they would provide the basis of a Stephenson

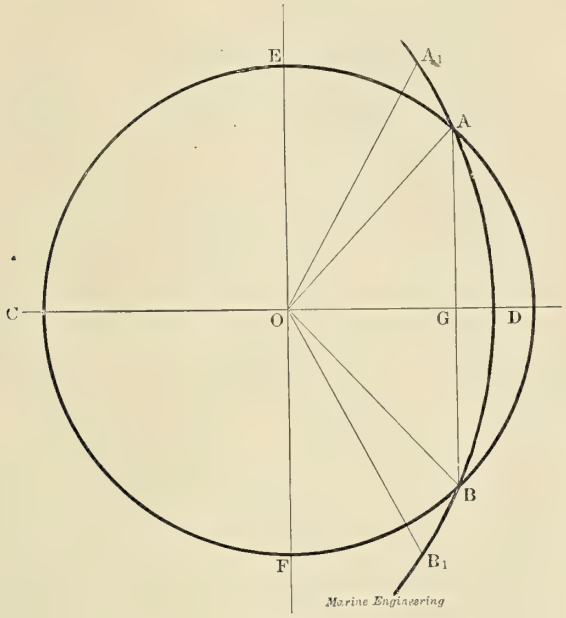


FIG. 27.

link which, when in full gear, would fulfill the specified requirements. The next step will be to determine the path of the end of the virtual eccentric by the method explained in [11]. This requires the determination of the distance *GD* which is measured by the expression $(g \times AG \div 2\ l)$, as explained in [11]. We must therefore proceed to the determination of the lengths of the link and of the eccentric rod. The length of the link should depend primarily on the distance *AB,* Fig. 27, or *PQ,* Fig. 28. Referring to the latter figure it is seen that the link *AB* has its greatest obliquity to the direction in which it must be moved to link up or reverse, when the engine is on or near the half stroke and the crank and eccentrics are located as shown. If this obliquity is excessive it is clear that on attempting to reverse the gear the block at *K* might stick in the link instead of sliding, and some part of the gear might be broken. In order to insure the smooth handling of the link in all positions, therefore, the angle *BRS* between the link and the bridle rod *SR* must not exceed such a value as experience may prove to be suitable for smooth operation under reversal and linking up. Experience thus indicates that the length of the link should be from three to four times the distance *PQ* Fig. 28 or *AB* Fig. 27. Within this range the length of the link may be selected with reasonable assurance of safe and smooth working.

The length of the eccentric rod is determined largely by that of the connecting rod. Care should be taken here to note that the length of the eccentric rod as here considered is its

geometrical length from P to A, Fig. 28, or from the center of the eccentric sheave to the center line of the link. It will be found in a general way that the length of the eccentric rod is not far from that of the connecting rod. The average vertical position of the lower end of both connecting and eccentric rods is the center line of the shaft, while in each case the upper end reaches upward to an average position somewhat below the cylinder and valve-chest casting.

Within a small limit of probable error, therefore, the lengths of the eccentric rod and link may be assumed in advance of the detailed and structural design. We are thus able to determine the distance GD, Fig. 27, and the locus ADB of the end of the virtual eccentric. If now the actual eccentrics to be fitted on the shaft are given a throw of OA, Fig. 27, and an angular advance of EOA, the link in full gear will realize the specified normal conditions. In most cases of actual design, however, it may be considered desirable to be able to realize conditions as to cut-off lying on both sides of the normal. That is, it may be desirable to be able to cut-off at a point slightly later than the normal as well as earlier, and thus in the former case to develop, perhaps for a brief time, an increased power and speed, even if the demand for steam under such conditions is greater than the boilers can normally supply. Such an arrangement is, in short, simply an emergency provision, but it may often be of great importance to provide for such possible increase of power, and thus to consider the normal running condition as belonging to a position of the gear slightly linked up rather than full gear.

In Fig. 27, suppose the curve ADB to be extended slightly at each end, and points A_1 and B_1 to be taken as shown. Then with but slight error we may take $A_1 DB_1$ as the locus of the outer end of the virtual eccentric for a pair of actual eccentrics represented by OA_1 and OB_1. For such a pair of eccentrics OA is a virtual eccentric corresponding to the position

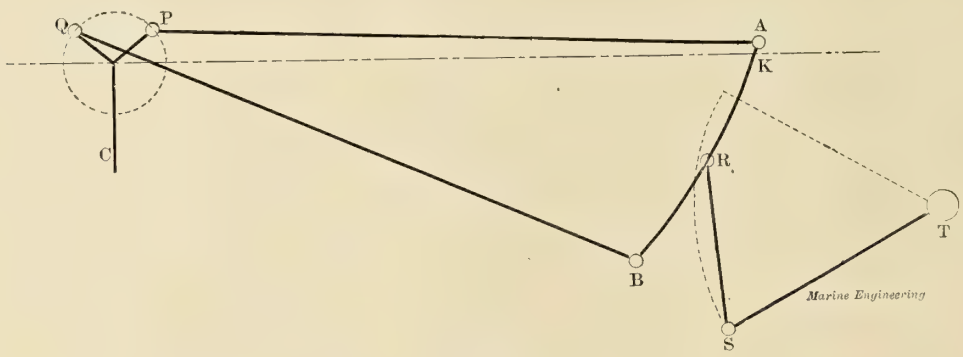


FIG. 28.

of the block linked up from A_1 to A or whatever fraction of the half link $A_1 A$ may bear to $A_1 D$. If, therefore, we fit a pair of actual eccentrics, as represented by OA_1 and OB_1, we shall be able to realize the normal schedule of operation by linking up to A, while at full gear the cut-off will be later and port opening greater, as determined by the eccentric OA_1. We shall thus provide for the emergency development of increased power at full gear with the block at A_1, for normal power with the block at A and for reduced power with the block at points between A and D. The relative length of $A_1 A$ to $A_1 D$ is wholly a matter of judgment. It may be usually taken at 1-8 to 1-6 or even greater if desired.

The actual eccentrics OA_1 and OB_1, as thus fitted, are therefore different from those first determined by the Bilgram diagram OA and OB, in having, as shown, a greater throw and decreased angular advance.

There still remain for determination the following items of the gear:

Location of rock-shaft center: T, Fig. 28.

Length of rock-shaft arm: TS, Fig. 28.

Length of bridle rod: RS, Fig. 28.

Location of reverse or saddle pin: R, Fig. 28.

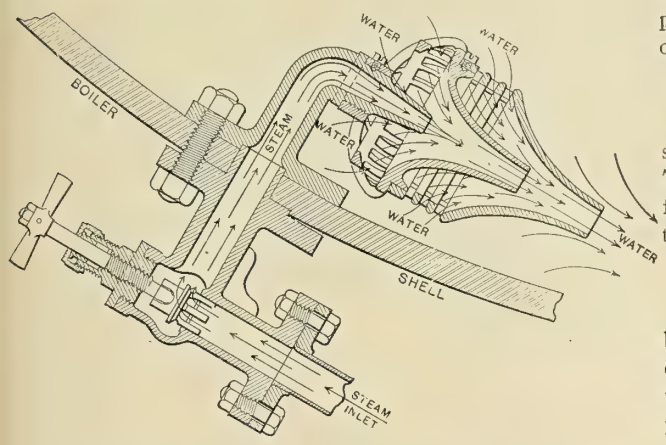
It is readily seen that these various items are not independent, and they must therefore be considered one with reference to another. It is also found that, in particular, the locations of R and of T exercise a noticeable influence on certain features of the operation of the gear, especially as regards the block slip, and the possibility of adjusting or equalizing the points of cut-off on the two strokes.

These various effects are of sufficient importance to warrant consideration in some detail.

QUERIES AND ANSWERS.

Q. 193.—Please give information and sketch of a hydrokineter and where it is attached to boiler, and explain its use. W.

A.—In answer to this we reproduce the cut and description of the hydrokineter in PRACTICAL MARINE ENGINEERING.



This is an appliance used to force the circulation of the water in the boiler, more especially when raising steam. It consists, as shown in cut, of a steam jet and series of nozzles with frame perforated at the back for the entrance of water. The steam is furnished from another boiler, and by its inducing action a current of water is set up and driven along, as shown by the arrows. This arrangement is placed near the bottom of the boiler and thus serves to drive out the cold water which tends to collect there, and which is only slowly heated by the operation of natural circulation.

Q. 194.—The engine of my stern-wheel boat is a compound, 10 and 20 inches by 48 inches stroke; cut-off, 3-4 stroke; steam, 150 pounds; wheel, 14 feet diameter, 27 turns per minute; the receiver is a 5-inch pipe, 14 feet long; and the engine is worked with a condenser at 20 inches vacuum. What results could I reasonably expect by increasing the pressure to 250 pounds by using water-tube boiler? E. L.

A.—First let us calculate what the mean effective pressure of your engine is reduced to the low-pressure cylinder. There are 5.33 expansions of steam in your cylinder from the point of cut-off to the full volume of the low-pressure. This is found by figuring the volume in cubic inches of the low-pressure and the volume of the high-pressure up to the point of cut-off, and dividing one by the other. Or,

$$\frac{314.16 \times 48}{78.54 \times 3\text{-}4 \times 48} = 5.33.$$

The absolute steam pressure of the boiler is 150 + 14.7 = 164.7. This at the engine is reduced to about 161 pounds, we will say.

Now from the formula, the theoretical mean effective pressure will equal the absolute pressure times a factor which is found in all books containing steam tables, which for this case = .5. From this product the back pressure must be subtracted, and in this case of 20 inches vacuum the back pressure is about 5 pounds.

Thus (161 × .5) − 5 = 85.5 pounds theoretical M.E.P.

To allow for clearances, condensation, etc., the theoretical pressure must be multiplied by another factor called the card factor, to reduce it to the actual M.E.P. For a single-expansion engine this will be about .75, so multiplying the above by .75 we have:

$$85.5 \times .75 = 84.1 \text{ M.E.P.}$$

If you increase your initial steam pressure by 100 pounds, and cut steam off at the same point, the above operation is changed.

$$(261 \times .5) - 5 \times .75 = 94.1 \text{ pounds M.E.P.}$$

It is probable, however, that with the increased pressure you would bring the cut-off, say, to one-half stroke. Then there would be 8 expansions and the constant found in the book corresponding to this is .385. Then the mean effective pressure would be:

$$(261 \times .385) - 5 \times .75 = 69.7 \text{ pounds M.E.P.}$$

It is probable that if you should not change the cut-off, by reason of the increased steam pressure you could drive the engine at the neighborhood of forty turns, while with the cut-off at one-half stroke the wheel would probably be driven thirty revolutions per minute.

Another great advantage of higher steam pressure is that with the increased number of expansions in your cylinder you reduce the steam per revolution.

Graphite Separator.

Editor MARINE ENGINEERING:

In your December issue, one of your readers states his need of a graphite separator. As I have done a great deal of experimenting with graphite, I am in a position to help him out of his difficulty. The accompanying sketch shows a graphite separator made by me several years ago, and as it worked very successfully, I take pleasure in offering this design to your readers. Of course, for use on board ship it is too bulky, but as some of my experiments in this line have proven that graphite in the exhaust steam is very good for surface condenser tubes as well as the heating surface of a boiler, I would advise the marine engineers not to worry about separating it.

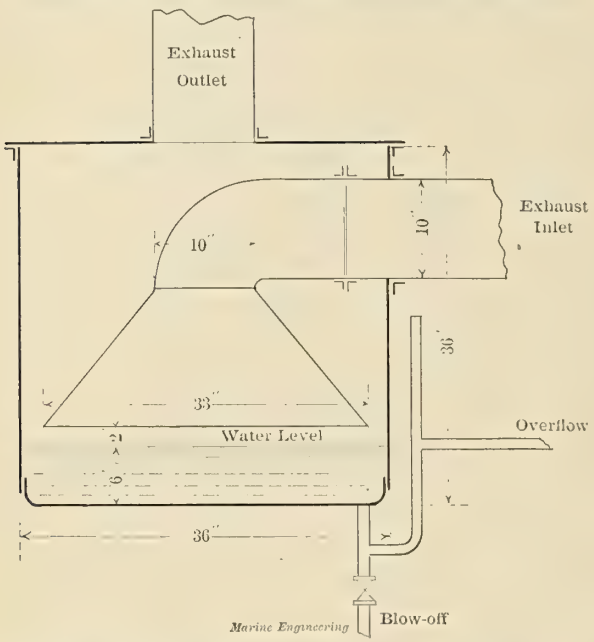
The construction of the separator is very simple. The main part is a sheet-iron tank, into one side of which the exhaust pipe passes; inside of the tank the pipe is turned downward, and ends in a large cone. This cone contains four brass wire screens, of No. 20 wire, the upper one with 8 meshes to the inch, and the others with 10. These screens serve to break up the current of steam. The bottom of the tank is covered with water to the depth indicated, and is provided with overflow and blow-off.

The engine to which this arrangement was attached was a 20x42-inch single-cylinder Corliss engine, driving a small ice machine. The exhaust of this engine was 8 inches diameter, but a short distance from the engine I increased it to 10 inches of spiral riveted pipe, of which all the rest to and from the separator was made; this was done in order to reduce the velocity of the exhaust steam. The cover is held down by bolts, and can be removed for cleaning; for this purpose the exhaust pipe is flanged close to the bend, so the cone can be removed and the wire screens cleaned, which was

found to be necessary about once in four years. The operation will be clear by examining the cut.

I also wish to state that, when using graphite, it should not be mixed with oil, but should be poured dry into an ordinary tallow cup, and a little pure water poured on top of it. If the engineer wishes to use both graphite and oil, it is advisable to use them in separate cups.

For gas engine cylinder lubrication I have used quite extensively powdered soapstone as a lubricant, and found it to give most excellent results. The successes obtained with this lubricant in cylinder and valve chests,



when using superheated steam in steam engines, was also quite unexpected. The hotter the cylinder walls were the better the soapstone served as a lubricant. It is most important that the soapstone used should be free from grit.

I will be very glad to communicate with any of the readers of Marine Engineering on the subject of graphite lubrication, and graphite separators as well as soapstone lubrication, if they care to address me through these columns. W. E. Raabe.

PERSONALS.

B. G. Londen has been appointed mechanical engineer of the New York Shipbuilding Company.

N. S. Braden, formerly of the Westinghouse Electric and Manufacturing Company's district office at Cleveland, Ohio, has been appointed sales manager of the new Canadian Westinghouse Company, Limited. He succeeds the late Thomas C. Frenyear, who died on December 10 of last year, with headquarters at Hamilton, Ontario.

Stephen M. Tasker, who has been connected with the Cramp Shipbuilding Company for twelve years, has been appointed chief draftsman of the Bureau of Steam Engineering at the Norfolk Navy Yard.

Fred. A. Peacock, of the engineering department of the Bath Iron Works, has accepted a position with the Mallory Line in the engine department of the new twin-screw coasting steamer *San Jacinto,* recently built by Roach's Ship Yard.

W. E. Joynes has severed his connection with the hull department of the Bath Iron Works to accept a similar position with Fore River Ship and Engine Company.

William B. Newton, formerly an engine draftsman at Bath Iron Works, is now with Fore River Ship and Engine Company.

R. L. Newman has removed his office to 66 Broad street, New York, N. Y., and become associated with Weir Merryweather. They will continue their business of naval architecture and consulting engineering.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports under date of January 13, 1904, the following degree of completion of vessels building for the United States Navy:

			Per Cent. Degree of Completion.	
BATTLESHIPS.			Dec. 1	Jan. 1.
Missouri	18 knots.	Newport News Co	99.1	99.9
Ohio	18 "	Union Iron Works	83.5	84.5
Virginia	19 "	Newport News Co.	50.4	52.5
Nebraska	19 "	Moran Brothers Co.	33	35
Georgia	19 "	Bath Iron Works	40	42.5
New Jersey	19 "	Fore River S. and E. Co	48.9	49.43
Rhode Island	19 "	Fore River S. and E. Co.	48.8	50.61
Connecticut	18 "	Navy Yard, New York, N. Y.	24.7	26.7
Louisiana	18 "	Newport News Co.	31	34.5
Vermont	18 "	Fore River S. and E. Co.	1	2.7
Kansas	18 "	New York Shipbuilding Co.	2	2.6
Minnesota	18 "	Newport News Co	8	12
ARMORED CRUISERS.				
Pennsylvania	22 knots.	William Cramp and Sons	63.2	64.9
West Virginia	22 "	Newport News Co.	67.3	70.5
California	22 "	Union Iron Works	48	51
Colorado	22 "	William Cramp and Sons	67.4	69
Maryland	22 "	Newport News Co.	63.1	65.4
South Dakota	22 "	Union Iron Works	44 5	47
Tennessee	22 "	William Cramp and Sons	12 9	15.1
Washington	22 "	New York S. B. Co.	9.7	12
PROTECTED CRUISERS.				
Denver	17 knots.	Neafie and Levy	98	98
Des Moines	17 "	Fore River S. and E. Co.	96	97
Chattanooga	17 "	Lewis Nixon	72	72
Galveston	17 "	Wm. R. Trigg Co	69	70
Tacoma	17 "	Union Iron Works	96.5	99
St. Louis	22 "	Neafie and Levy	34.8	36.2
Milwaukee	22 "	Union Iron Works	38.5	41
Charleston	22 "	Newport News Co.	55.2	56.9
GUNBOATS.				
Dubuque	12 knots.	Gas Engine and Power Co.	15	20
Paducah	12 "	Gas Engine and Power Co.	13	16
TRAINING SHIPS.				
Cumberland	Sails	Navy Yard, Boston	7	12
Intrepid	"	Navy Yard, Mare Island	0	5
TRAINING BRIG.				
Boxer	Sails	Navy Yard, Portsmouth	3	6
TORPEDO BOATS.				
Stringham	30 knots.	Harlan and Hollingsworth	93	93
Goldsborough	30 "	Wolff and Zwicker	99	99
Blakely	26 "	George Lawley and Son	99	99
Nicholson	26 "	Lewis Nixon	99	99
O'Brien	26 "	Lewis Nixon	98	98
Tingey	26 "	Columbian Iron Works	100	100
STEEL TUGS.				
Pentucket	12 knots.	Navy Yard, Boston	96	100
Sotoyomo	12 "	Navy Yard, Mare Island	95	98

TECHNICAL PUBLICATIONS.

The Practical Physics of the Modern Steam Boiler. By Frederick J. Rowan. Size 6 by 9 inches. Pp. 638, with 314 figures in the text, and introduction by Dr. R. H. Thurston. D. Van Nostrand Company, New York. Price $7.50.

The title of this comprehensive work admirably suggests the point of view and mode of treatment which the author has chosen for his discussion of this all-important feature of our modern material civilization. He has treated the subject primarily with reference to the physical laws which relate to the steam boiler and their practical application to the various problems which the design, construction, operation, and especially the improvement of the modern steam boiler present.

The work, as a whole, is divided into nine chapters, of which the first is introductory and has especial reference to the lines which the development of the steam boiler has followed, and the particular points which a good boiler should possess.

Chapter ii. then proceeds with the fundamental elements of boiler design, particularly with reference to the problem of strength under the various complex stresses to which the boiler as a structure is subjected. In chapter iii. the general topic of combustion is considered with reference to the chemical operations involved and the heat liberated, and with reference to the various practical methods for controlling, perfecting, and forcing the combustion employed in actual steam boilers. Air heaters, mechanical stoking, methods for the use of dust fuel, gas, and liquid fuel, receive full notice, and the chapter closes with a reference to the experiments in 1899 of the Navy Department on the Great Lakes with stokers for marine service. In chapter iv. the transmission of heat through the plates forming the heating surface is considered. This is taken up primarily with reference to the established physical laws, and a large amount of information is given derived from numerous experiments bearing on this topic, which are also discussed with reference to various equations and formulæ which have been proposed for expressing the relation between the transmission of heat and the attendant conditions. In chapter v. the circulation of the water is dealt with in the same general manner. The fundamental physical laws are first presented, and their application to the circulation of water in a boiler is then discussed. The subject of this chapter is of special importance in view of the recent extended discussions regarding the circulation of the water in boilers of the water-tube type, and in this chapter will be found a comprehensive summary of the more important of these discussions, and with reference to the attendant experimental results when such were carried out in connection with the study of the problem referred to. In chapter vi. the subject of the strength of materials entering into the boiler is again taken up, with especial reference to the influence of heat on the tenacity and ductility of such materials. Many experimental results are given and the general topic is discussed with reference to its effect on the problems of steam boiler design. In chapter vii. the important topic of corrosion and incrustation is dealt with in the same thorough manner. The chemical and physical laws bearing on the question are discussed, a historical résumé of the development of the difficulty in marine practice is given, and various methods for the control and prevention of these harmful actions are described and discussed. In chapter viii. the subject of boiler design is taken up chiefly from the historical and descriptive points of view. The various types and styles of boilers are briefly described and considerable attention is given to the vast multiplicity of examples furnished by the modern water-tube type. The term design, in the heading to this chapter, relates rather to construction than to the adaptation of size and proportion to the realization of a stated schedule of conditions. In chapter ix. the subject of boiler tests and results is taken up. Reference is made to the more prominent of the tests which have become historical, and a large amount of valuable information is given in connection with the results of more recent tests under modern conditions.

The author in his preface states clearly that he has not cared to follow the well-beaten paths of former works, and that he is not so much concerned with actual or existing practice as with the directions along which improvement and development should proceed. He points out that this brings a certain change in the point of view, and that in consequence the point in regard to fuel, for example, is not so much the existing ratio of fuel consumed to grate area, but rather what is the largest quantity which can be burned in a given time, with or without a grate, with the minimum labor and maximum efficiency. So with many other features, and throughout the work the author has given less attention to existing practice than might perhaps have been expected in a work on this subject. It is perhaps this point of view which has led him to dispense with any adequate discussion of the subject of design. The subject matter of chapter ix. is in effect the relation between the boiler as a structure and the boiler as a steam generator, and it would naturally serve as the direct foundation for a discussion of boiler design so far as the determination of characteristics and proportion is concerned. This important part of the subject, however, seems to be for the most part lacking. The engineer or student who is seeking guidance in the design of the boiler as a steam generator will, it is true, find an abundance of fundamental facts from which such design may be developed, but he will not find collected together a clear and comprehensive discussion of the principles of design, and will receive small aid in this particular part of his study of the boiler. It cannot be too clearly understood that in all engineering design note must be taken of two distinct divisions of the work: the design, so far as characteristics and proportions are concerned, and the design as a structure. The first fixes the leading features of the design in terms of fundamental characteristics and essential ratios and proportions; the second has for its aim the realization of the preceding ideal or abstraction in a definite and safe engineering structure. The principles underlying the latter field of design will be found discussed in the present work, though some might perhaps wish for a closer contact with actual practical construction as determined by the rules of the leading registration societies and governmental boards. This, however, is purposely omitted from the author's scope and must be sought elsewhere as needed. The

first or fundamental field of design, however, is scarcely noticed, and constitutes a real shortage in what might seem to be fairly within the proper scope of the book.

Having disposed of this word of criticism as to the policy of the author it is a pleasure to refer to the excellent work which the book shows throughout in the field as covered by his design. The high reputation of the author as a writer and as an engineer lead us to expect a judicious selection of the subject matter to be actually presented, an accurate and logical presentation of such matter in detail, and a clear and illuminating discussion of the subject throughout. In this we are not disappointed and the book in general meets our just expectations in these respects.

In one or two instances a good illustration is furnished of the rapidity with which facts grow old and change or lose significance. Reference is made at the close of chapter iii. to what are termed "recent experiments" made by the United States Navy Department on certain steamers on the Great Lakes fitted with automatic stokers. From the terms used in referring to the results the casual reader might suppose them recent, relative to 1903 instead of 1900, when this part of the book was written, and that the problem of the firing of coal in marine boilers was likely to be immediately and profoundly influenced by these experiments—conclusions which the actual facts have not justified.

The book as a whole is a most valuable and welcome addition to the literature on the subject, and the author may be properly congratulated on having furnished a solid addition to the discussions available to the progressive engineer on the leading topics relating to the improvement of the modern steam boiler. The aim of the author seems to have been, in a word, the comprehensive presentation and discussion of the physical laws on which the operation of the steam boiler depends, with facts drawn from experience and illustrations from practice, all with a view to the further improvement of the boiler as a steam generator and as an engineering structure. In such purpose he has been successful to a marked degree, and the work may be recommended to all who are especially concerned with this aspect of the problem presented by the modern steam boiler.

Machine Design, Part I., Fastenings. By William Ledyard Cathcart. Size 6 by 9 1-2 inches. Pp. 291, with 119 figures and diagrams in the text. New York: D. Van Nostrand Company. Price $3.00.

The purpose of the author in preparing this work has been to present in compact form for the use of the student and designer the best modern American data and practice in this branch of the broad field of machine design. Mechanisms and engineering constructions of all kinds are, with few exceptions, made up of various members, and these parts must be fastened together. The general subject of fastenings is therefore one of great importance for both the designing and constructing engineer.

In the present work the subject is treated both theoretically and from the standpoint of practice, thus giving a very full and satisfactory discussion of the general ground covered. The field is divided into five chapters dealing with shrinkage and pressure joints, screw fastenings, theory of riveted joints, practice and results with riveted joints, keyed and pin joints.

Under pressure and shrinkage joints the treatment is especially full and the discussion of formulæ and of practice should be especially acceptable to engineers who may be called on to deal, on a large scale, with fastenings of this character. Of especial note in this chapter are the formulæ developed by Professor Alger, U.S.N., for the shrinkage stresses developed in the assembling of modern hooped ordnance, with illustrations of the details as shown in the design and construction of a modern high-powered gun.

Under the head of screw fastenings a full discussion is given of the theory of the screw, including friction and the consequent stresses developed in both the bolt and nut under various complex conditions. A large number of tables are also given presenting in compact form a large amount of data for the immediate use of the designer and engineer. Of especial note here is the excellent treatment of locks and fastenings to prevent the loosening up of screwed joints under jarring and periodic stress.

The general subject of riveted joints, from its great importance, naturally receives large attention. The theory is necessarily imperfect, due to our ignorance of the distribution of stress in both the plate and rivet. On the usually accepted basis, however, a very full and clear exposition is given, and the various proportions for riveted joints of all practicable types are deduced in accordance therewith. A large amount of tabular matter is also given, together with the results of a large number of tests on joints of various types.

The subject of keyed and pin joints is taken up with the same thoroughness of detail both in theory and practice, and this section gives a most satisfactory presentation of the general subject of fastenings of this type.

Taken as a whole this book constitutes a most useful contribution to the literature of machine design. In perhaps no other work relating to the modern engineering practice is the general subject of fastenings treated with the degree of thoroughness and balance, both from the viewpoints of theory and practice, which is here found. The volume should form a most acceptable addition to the working library of every designing and constructing engineer.

Sexton's Boiler-Makers' Pocket Book. By Maurice John Sexton. Size 5 by 3 inches. Pp. 319, with diagrams. New York: Spon and Chamberlain. Price $2.00.

This is the sixth edition of a work on boiler construction which has long been favorably known throughout the boiler-making and shipbuilding trades. The book was originally prepared as a working pocket book for the daily use of the author, and to avoid the need of making calculations at the moment wanted, and to remove the chance of mistake under such circumstances. It contains the usual tables of areas and circumferences, proportions of riveted joints, points on laying out and building boilers of the usual types, together with special tables and data useful in many problems with which the boiler maker is called on to deal.

The book contains also chapters on steel masts and yards for ships, and on shipbuilding. The author would

have done better to stop with the boiler section. The chapter on shipbuilding is too short and too heterogeneous to be of any great value to the shipbuilder.

Within the field of boiler construction, however, this work contains a large amount of information, and in convenient form for the every-day needs of the boiler maker or sheet-metal worker.

Mechanical World Pocket Diary and Year Book for 1904. Size 6 by 4 inches. Pp. 278, including diary. Price 6d. Emmett and Company, Ltd., Manchester, England.

This, the seventeenth annual issue of the diary, has some special features, which are: sections on the valve diagram, completely rewritten and amplified; a table giving the calculated results for moduli of many sections; tables for weight of copper bars, others on the stresses of bolts, pipe fittings, and further formulæ. In general, the work has been revised and brought up to date.

The Increase in the Size of Mercantile Steamers, with Reference to their Economic Return. By C. B. Schultz. Size 7 1-2 by 10 inches. Pp. 111, with many diagrams and tables. Berlin: M. Driesner. Price $2.50.

This is a publication in German of a thesis for the degree of Doctor of Engineering, presented before the faculty of the Technical High School at Berlin, the most famous of the German engineering schools.

The book as published represents the results of a special investigation into the relation between the size of ship and her various characteristics and features, especially in regard to their weight and their influence on the capacity and economic performance of the ship. The investigation was directed along two main lines, one having reference to a high-speed, fine-lined type similar to the *Deutschland,* and the other having reference to a full-formed cargo steamer of moderate or low speed, of which the *Palatia* was taken as the example. These types were also carried out in various ways according as special weight is to be given to the carrying of cargo without reference to other considerations, to the cargo with reference to the cost of the ship, or with reference to the cost of the machinery and the expense of operation.

In the detail of the work a vast number of formulæ have been developed and a series of tables and graphical charts are given, all having reference to the weight of the various elements entering into the ship, and with regard to the various special conditions to be fulfilled. The question of the bending moment, the necessary strength for the conditions to be fulfilled, the indicated horse power, and the various relations of these items to the question of the economic returns are likewise discussed in the same thorough manner.

The work throughout is of the exhaustive, painstaking character so typical of German research, and will prove a valuable mine of suggestive method and information to those interested in this branch of the subject and who may be able to read the German language, in which the book is alone at present accessible.

Practical Lessons in Electricity. Size 7 by 10 inches. Pp. 226, with numerous cuts. American School of Correspondence, Armour Institute, Chicago.

According to the preface this volume contains four of the forty-five text books in the electrical engineering course of the American School of Correspondence at the Armour Institute of Technology. The purpose is to give the public an opportunity to judge of the standard and scope of the instruction offered, and while only fragmentary as regards the entire course offered, it is hoped that in itself the volume may not be without value to the expert electrician as well as to the amateur.

The volume contains four pamphlets treating on the elements of electricity, on the electric current, by L. H. Sager; electric wiring, by H. C. Cushing, Jr.; and on storage batteries, by F. B. Crocker. The treatment of the subject matter is necessarily simple and practical in order that it may be adapted to the needs of the correspondence method of instruction. A large amount of practical information is, however, contained in these chapters, and if they form fair samples of the whole number the course in electrical engineering would seem to be eminently practical and admirably adapted to the class of students held especially in view by this method of instruction. The absence of any index and the separate paging of the chapters make the present volume of less value than it might have been were it published with more direct reference to use in the present form.

Record of American and Foreign Shipping. 1,300 pages. 8 by 9 1-2 inches. Price $5.00. American Bureau of Shipping, 66 Beaver street, New York, N. Y.

The volume for 1904, which is the thirty-sixth annual issue of this valuable register, is now being delivered to subscribers. The Record contains full reports and particulars of about 17,000 vessels, ranging from the infrequent ketch to the full-powered transatlantic liner, and flying the flag of every nation, alphabetically arranged with much detail as to build, ownership, and condition. This information forms the bulk of the annual volume, but it also contains rules for the construction and classification of all classes of vessels, with illustrations and tables, all of utmost technical and practical value; revised rules for the construction of machinery and boilers, electric installation, and refrigerating apparatus on shipboard.

The volume contains names of vessels which have been changed; list of compound names arranged alphabetically by last word of name for ready reference; list of addresses of prominent shipbuilders, dry-docks, and marine railways of the United States; list of owners of vessels, all of much value to the shipping interests. The work is approved and endorsed by the important boards of underwriters of the United States and is accepted by the merchants and underwriters throughout the world as a standard classification of shipping.

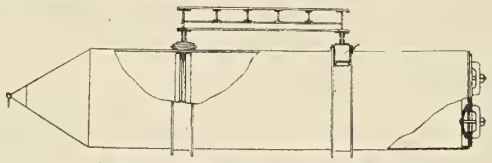
Supplements to the volume, issued semi-monthly, keep subscribers informed of new vessels constructed during the year; with reports of repairs to old vessels and other useful information.

Practical Engineer Pocket Book for 1904. Size 5 1-2 by 3 1-2 inches. Pp. 576, with 64 pages for diary on ruled sectional paper. Gilt edges, flexible morocco. Price 1s. 6d. Technical Publishing Company, Manchester, England.

This forms the sixteenth annual edition of this pocket book, which has been revised and brought up to date. Alterations and additions have been made, among which is a description of the Sterling water-tube boiler, the Daimler motor, and notes on patents and patent law. It is a convenient edition for the engineer.

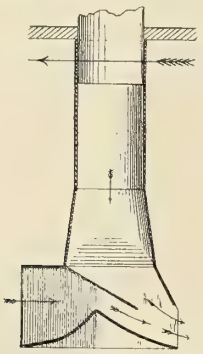
SELECTED MARINE PATENTS.

745,192. FLOATING BRIDGE. HERMANN KAMPMANN, KREIS ESSEN, GERMANY.



Claim.—1. A floating bridge supported by closed pontoons which are arranged turnable around their longitudinal axis so that each pontoon can be turned round to allow an inspection of all parts and particularly those which had been under water and to permit further an easy exchange of pontoons—all without interruption in the use of the bridge. Five claims.

744,950. VENTILATOR FOR SHIPS. CHARLES A. WITHERS, AUGUSTA, GA.



Claim.—1. In a ventilator for ships and the like, a casing having a passage therethrough, communicating with the space to be ventilated, the inlet opening to said passage being directed toward the wind and having an inwardly-inclined wall, an outwardly-inclined wall or extension leading from the rear end of said inwardly-inclined wall, and a deflecting blade lying substantially parallel to the latter wall or extension and located at the point of intersection of the passage through said casing with the passage leading to the space to be ventilated, the said blade forming a contracted portion in the passage through said casing into which said inlet opening leads, and terminating at its rear end a short distance from the rear end of said outwardly-inclined wall or extension. Two claims.

745,469. APPARATUS FOR SUBMARINE WORK. CHARLES WILLIAMSON, NEWPORT NEWS, VA. Twenty-one claims.

745,732. PROPULSION MECHANISM FOR VESSELS. HENRY H. LITTLE, PHILADELPHIA, PA. Four claims.

745,853. PROPELLER. HENRY C. INGRAHAM, NEW HAVEN, CONN.

Claim.—1. A propeller-blade a cross-section of which at any and all points between the hub and outer end represents a segment of a cycloidal curve and the curved portions being formed from generating circles whose diameters increase from the hub outwardly. Three claims.

745,871. SCREW PROPELLER. JAMES B. MACDUFF, BROOKLYN, N. Y.

Claim.—1. A propeller, consisting of a hood or casing, a hub and blades connecting said hub and hood or casing, said hood or casing flaring outwardly from its rear to its forward end, and said hub tapering from its rear to its forward end, at which point it is of less diameter than at its rear end. Three claims.

745,910. PROPELLING VESSELS. CHARLES F. SAUTTER, BROOKLYN, N. Y.

2. A vessel having a driving shaft and driving gear therefor, a way and a swinging-deck section, and tracks on the way and at the under face of the deck-section, so that as the latter is swung open or outward the track-sections at the movable deck are exposed to form a continuation of the track sections on the way, said movable deck section having prongs or catches for securing a hold and said tracks registering with the gear for running a vehicle to and from engagement with the gear.

3. A vessel comprising a rudder, a driving shaft and driving gear, and a track adapted to receive a vehicle and hold the driving wheels thereof to the gear, said track having pivoted sections to enable the steering wheels of the vehicle to swing when connected to the rudder.

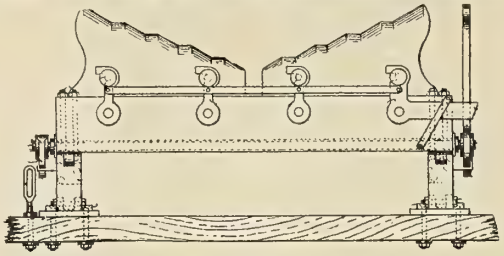
4. A vessel comprising a driving or propelling shaft, a gear for operating the shaft, and a way or tracks registering with the gear to permit of an automobile or like vehicle to be run to and from engagement with the gear. Four claims.

746,007. PROPELLER. EWALD BRUNCKER, COLOGNE, GERMANY.

Claim.—1. A propeller having a dished propeller-blade, thinnest at the middle portion and gradually increasing in thickness to the sides and ends, the entrance and exit edges being beveled. Six claims.

746,169. RELEASING DEVICE FOR SHIPS' BOATS. WILLIAM H. ROTHWELL, LONDON, ENGLAND.

Claim.—1. In combination in a releasing device for boats, chocks for holding the boat, a beam supporting the chocks, supports for said beam and a lever for collapsing said supports.

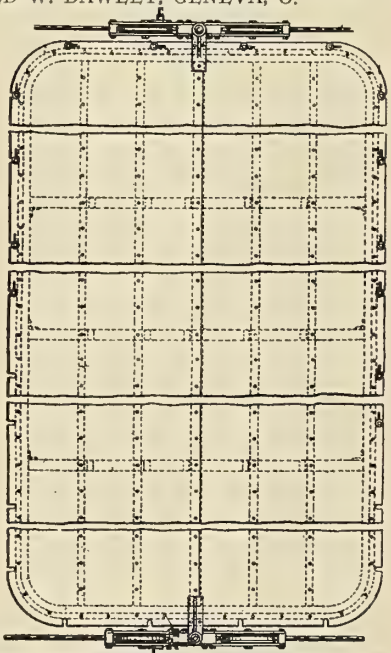


2. In combination in a releasing device for boats, chocks for the boat, a beam supporting the chocks, collapsible supports for the beam comprising a number of plates hinged together, a lever, a shaft connected thereto, and means on the lever and shaft for collapsing said support. Four claims.

746,606. SUBMARINE BOAT. DANIEL F. TOOMEY, GUILFORD, CONN.

Claim.—1. In a boat of the character described, the combination with the hull, of vertical guides extending from the deck to the bottom and forming internal braces for the hull, a tubular conning tower fitted to slide vertically between said guides, and means for raising and lowering said tower. Five claims.

746,929. HATCH COVER FOR MARINE VESSELS. WINFIELD W. DAWLEY, GENEVA, O.



2. A hatch cover, comprising a cover proper or top, longitudinal and transverse braces under the same and arranged to give the cover a crown or rounding form for the purpose specified, and means engaging the edges of the cover to raise the same.

4. The combination of a hatch cover, a truck therefor, and means for raising the cover on and lowering the cover from the truck.

5. The combination of a hatch cover, a truck at each side thereof, and means for connecting the trucks with the cover.

6. The combination of a hatch cover, a truck therefor, and means connecting the cover with the truck and including an elevating device.

7. The combination of a hatch cover, a truck therefor, and means connecting the cover with the truck and includingg a jackscrew to permit raising and lowering the cover.

8. The combination of a hatch cover, a truck therefor, a gear in connection with one of the wheels of the truck, a second gear meshed with the first gear, and means for facilitating the operation of the second gear.

9. The combination of a hatch cover, a truck at each side thereof, a jackscrew mounted on each truck, and brackets attached to the cover and having the jackscrews respectively operating therein.

10. A hatch cover, comprising a body portion or top, and longitudinal and transverse ribs or braces fastened to the under side thereof. Ten claims.

746,995. FLOATING DISCHARGE PIPE FOR HYDRAULIC DREDGES AND MEANS FOR CONNECTING SAME TO DREDGES. ARTHUR W. ROBINSON, MONTREAL, CANADA. Fourteen claims.

746,996. APPARATUS FOR HYDRAULIC DREDGING AND DISTRIBUTING THE DREDGED MATERIAL. ARTHUR W. ROBINSON, MONTREAL, CANADA. Seven claims.

INDEXED

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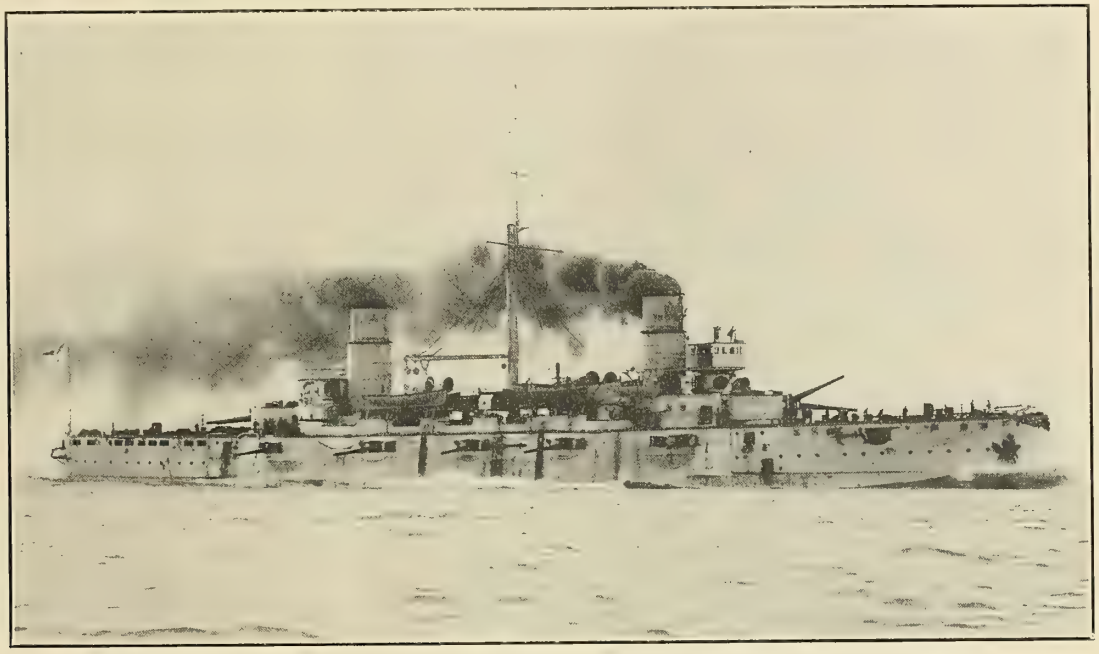
MAR 7 1904 ... PATENT OFFICE

NEW CRUISERS FOR THE JAPANESE NAVY.

The cruisers *Rivadavia* and *Moreno,* built by Messrs. Ansaldo and Company for the Argentine Republic, were recently sold to the Japanese government. These ships which were practically completed at the time of sale were rechristened the *Kasuga* and *Nisshin,* respectively, and started on the morning of January 9 for Japan.

Through our correspondent in Italy, the following information relative to these ships and their official trials are given:



JAPANESE PROTECTED CRUISER NISSHIN, PURCHASED FROM ARGENTINA, ON TRIAL NOVEMBER 6, 1903.

In the Italian naval programme, dating back to 1891, there was provided for the construction of a warship to be named the *Guiseppe Garibaldi,* to be built and engined complete and delivered to the government in six years from the date of contract. The contract was taken by Messrs. Ansaldo and Company, and the vessel was launched and the engines completed twenty-two months from the date of laying the keel; this was in June, 1895.

The relations between the Argentine Republic and her sister republic, Chili, became so estranged that war seemed imminent, and the two countries looked about to purchase warships to strengthen their fleets. Overtures were made by the Argentine Republic to the Italian government for the purchase of the *Garibaldi,* and it was arranged that the builders should have power to dispose of the vessel to Argentina on condition that a duplicate of the ship be delivered to Italy within the time originally stipulated for the first one; and with the proviso that the builders were to fit the new vessel with water-tube boilers in place of the cylindrical ones of the *Garibaldi,* and that all material of the new ship should be obtained in the Kingdom of Italy, as far as possible.

The name *Garibaldi* was retained for the Argentine vessel and she was speedily completed and handed over to the Argentine authorities. Fitting the machinery on board was a remarkably smart piece of work for any country, the engines and boilers being ready for their steam trial ten weeks after the vessel was launched. The keel of second ship was laid on September 25, 1895, and construction so pushed forward that she was ready for sea long before the time originally stipulated. It was at this juncture that Spain, seeing the urgent necessity of adding to her fleet some modern and really serviceable vessels, decided to purchase the *Garibaldi* No. 2, if it were possible, and the Italian government was again approached with a request for the sale of the second vessel. This was again granted on the same terms as before, but with a distinct warning from the Italian ministry of marine that on no account would any extension of time for final delivery be granted, and

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any fines for delay would be most strictly enforced. The launch of this second vessel took place on September 16, 1896, and she was christened the *Cristobal Colon.*

A third ship was laid down in October, 1896, launched in September, 1897, and rapidly completed, and again Argentina coveted her, and got her, the ship being named the *Pueyrredon,* fitted with Belleville boilers.

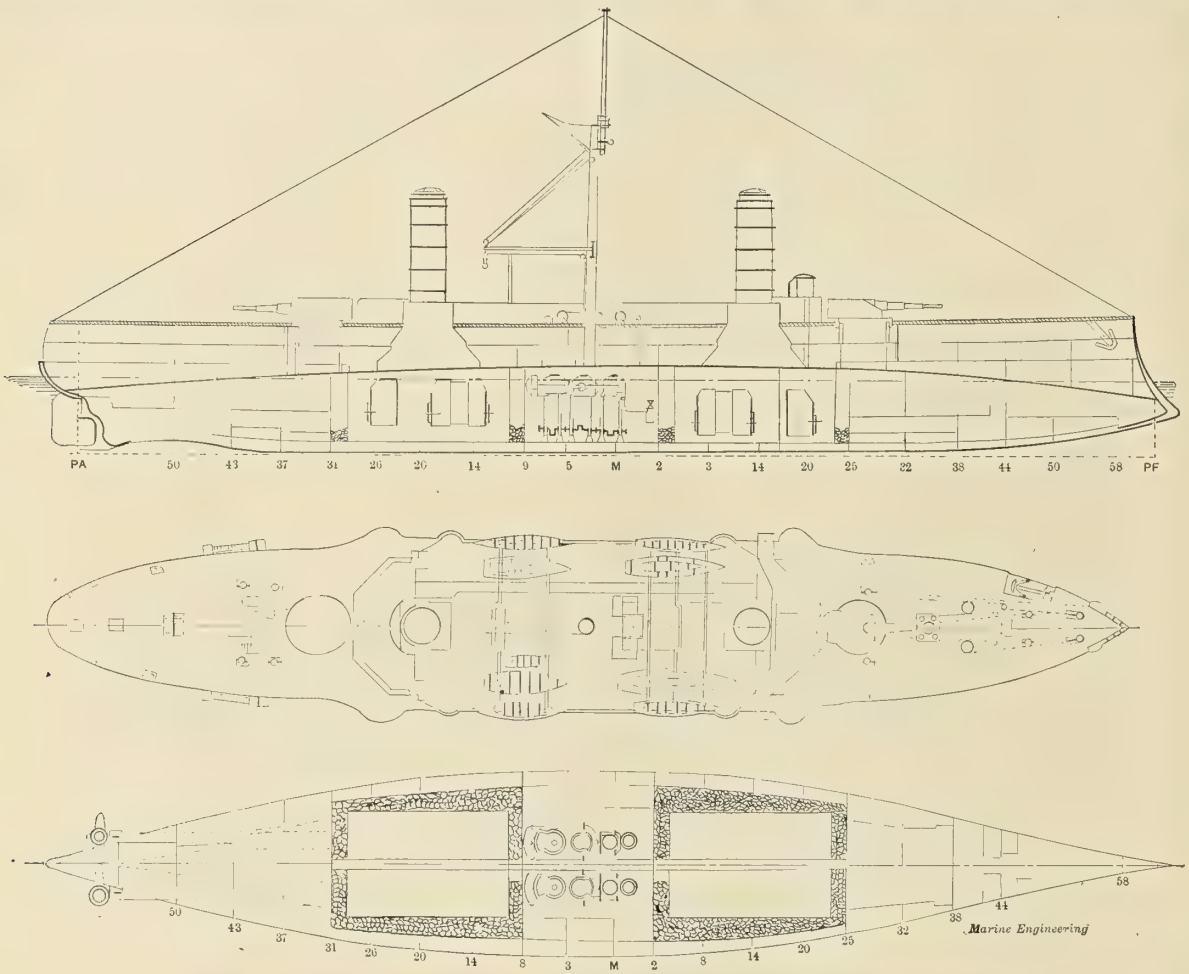
Messrs. Ansaldo now laid down the fourth and final ship for the original Italian order, and this is named *Guiseppe Garibaldi.* Her keel was laid in September, 1898, and the launch took place in June following, or about nine months from laying the keel. Construction of the vessel was well advanced at time of launching, the shafting was in place, and finished up to the engine room, auxiliary machinery was installed and all double bottom pipes and valves and bilge pipes and valves were fitted in place and finished.

These four vessels, it will be seen, have been floated within about four years from beginning of the first ship, which is a fine performance, and gives a good example of the rate of construction carried on in this yard.

Two new cruisers were contracted for by the Italian government and these were named the *Rivadavia* and *Moreno.* The over-all dimensions of these six ships, the arrangement of water-tight sub-divisions, disposing of armor, guns, and machinery, are much alike, but the details are worked out differently. The *Cristobal Colon,* the second vessel, presented some improvements which were found desirable or necessary from experience with the *Garibaldi.* Principle among these is the modification in the disposing of the 6-inch quick-firing guns at the forward and after ends, so that they may be brought to bear bow and stern on respectively.

Again have the ships from this famous yard passed into other hands. Argentina is now at peace with her neighbors and has entered into a close treaty with Chili by which both countries agreed to dispose of their new warships. When Japanese officials were looking for new ships for their government they were successful in purchasing from Argentina these two vessels, the *Rivadavia* and *Moreno,* and rechristened them the *Kasuga* and *Nisshin,* respectively. These ships are 357 feet over all, 344 feet between perpendiculars, 61 feet 4 inches extreme beam, 23 1-4 feet mean draft, 13,500 I. H. P., 7,400 tons displacement, and on trial attained a speed of 20 knots. The preceding ships are but 341 feet long over all, 328 feet between perpendiculars; 58 feet 8 inches beam, 23 feet draft, 6,882 tons displacement, 13,000 I. H. P., and 19 1-2 knots speed. The extra length of the two new vessels is given up to two more boiler rooms.

At the same time Chili offered for sale the two battleships *Libertad* and *Constitucion,* building for her in



ELEVATION AND DECK PLANS OF THE NEW JAPANESE PROTECTED CRUISERS KASUGA AND NISSHIN.

English yards; it is stated Russia made proposals for them, but they were sold to Great Britain.

GENERAL FEATURES.

In the case of the Japanese ships the offensive and defensive features were most carefully considered, the battery being so laid out that the maximum amount of destructive gun-fire can be concentrated against the enemy in any direction, the armor and water-tight bulkheads so disposed that the maximum protection is secured, and the propelling machinery and fuel such that the maximum speed and radius of action compatible are obtained. Another feature considered of utmost importance was that in housing the officers and crew in fitted with electric gear for manœuvering them from a distant point of observation. This will be a great advantage in the case of night attacks by torpedo boats, and, indeed, on all occasions when it is necessary to use them. The armor encloses a central redoubt, extending for half length of the ship, of 6 inches thickness on the sides and 4 3-4 inches at the ends. The side belt extends 5 feet above the water line and the same distance below the water line, and outside the redoubt the side armor tapers to 3 1-8 inches at the ends.

The boilers and engines are placed in six water-tight compartments formed by four thwartship and two longitudinal water-tight bulkheads. In each of the two forward compartments is one single and one double-end

JAPANESE CRUISERS KASUGA AND NISSHIN PROVISIONING AT CENOA JUST BEFORE SAILING FOR JAPAN.

the space available, their quarters be made as comfortable as possible, so that the men shall be in fit condition to get the best results out of the machinery.

The armament slightly differs from that of previous vessels, and comprises one quick-firing 10-inch gun placed in the forward barbette, on the *Kasuga,* and two 8-inch guns similarly mounted on the *Nisshin;* two 8-inch guns in the after barbette, and fourteen 6-inch rifles. The secondary battery includes ten 3-inch rapid-firing guns and four above-water torpedo tubes. The military tops with the two automatic Maxim guns were taken off. The steam hoists for ammunitions have been superseded by others of greater capacity, having electricity as their motive power, hand gear also being fitted. The electric gear for training and loading the 10-inch guns has been much improved, as also the electric firing gear for the smaller guns.

As the results of this extension of the uses of electricity on board, the electric plant has been increased 50 per cent., and four large dynamos are now fitted forward and two aft. The electric searchlights have been

boiler; in the midship compartments are the two sets of propelling engines, and in the after compartments are two boilers similar to those forward. The boiler rooms are completely surrounded both at ends and sides by coal bunkers. There are no doors between boiler and engine rooms below the water line, but all are accssible from a central gallery running along the center line of the ship with water-tight doors into each of these compartments. The engine rooms are also accessible through large skylights from the gun deck fitted with protective bars.

MACHINERY.

The main engines of each cruiser consist of two sets of three-cylinder, triple-expansion engines with cylinders 42 1-2, 63, and 93 3-4 inches diameter by 46 inches stroke, designed for 105 revolutions per minute and to develop 13,500 horse power collectively, with a steam pressure at engine of 160 pounds. The designed speed was 20 knots. The arrangement of cylinders and valves is as follows, starting at the forward end: high-pressure

piston valve, high-pressure cylinder, intermediate-pressure double-ported slide valve, intermediate-pressure cylinder, low-pressure cylinder, and the low-pressure double-ported slide valve at the after end of the engine. The sequence of cranks is as usual, namely, high, intermediate, and low-pressure.

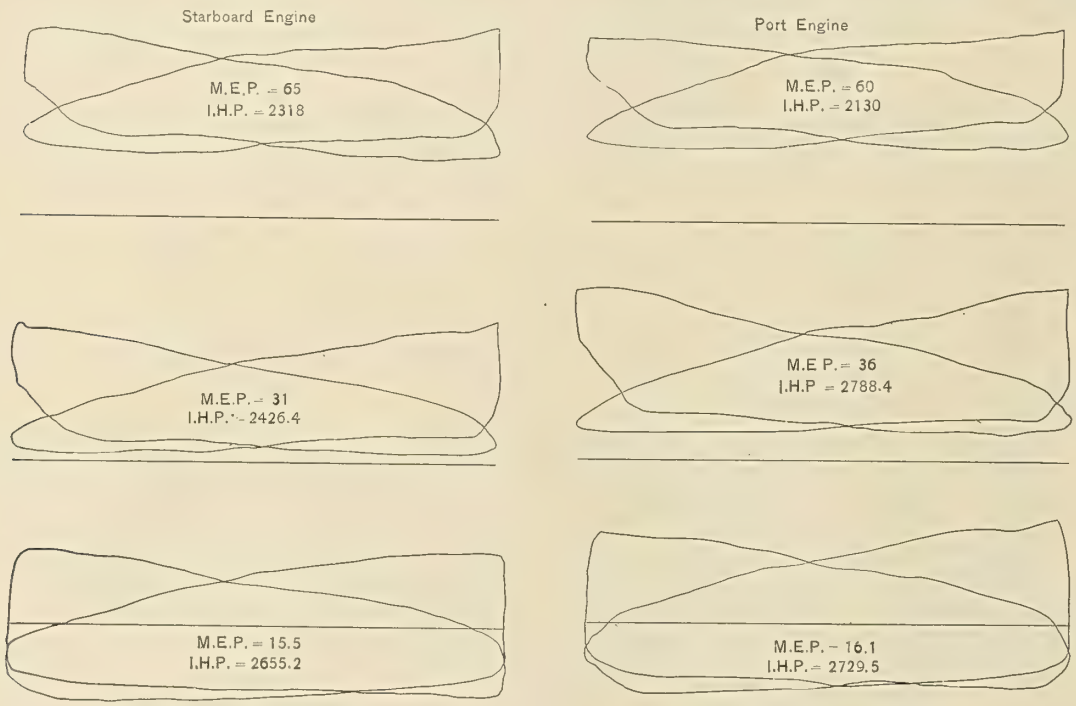
The high-pressure cylinder has one piston valve 28 inches in diameter, taking steam on the outside; the intermediate one double-ported slide valve, 53 inches wide by 59 3-4 inches long; and the low-pressure one double-ported slide valve, 60 1-2 inches wide by 90 inches long. All three valves are fitted with Joy's assistant cylinder.

The high-pressure cylinder and its chest are in two separated castings bolted together, while the intermediate and low-pressure cylinders have their respective chests in one piece with cylinder. Distance stays are placed between cylinder, allowance being made for expansion. The high-pressure cylinder has a 14-inch diameter opening for copper steam pipe on front of chest and the receiver consists of two copper pipes fitted with slip joints, one each side, 9 inches in diameter. The intermediate cylinder exhausts into two pipes 17 inches in diameter, to low-pressure chest, while the low-pressure cylinder exhausts through a 31-inch diameter copper pipe with a slip joint at condenser.

The cylinders are jacketed. A 2 1-2-inch copper pipe connected to throttle-valve casing supplies steam to intermediate and low-pressure cylinder chest directly for starting, and supplies steam for jackets; the circution of steam through jackets is not continuous from one cylinder to the other, but drains at each one, and the pressure is reduced at intermediate and low-pressure cylinders. The lagging of cylinder and chest is of steel varnished, with vertical joints. The filling in with non-conducting material is most thorough, bonnets, sides, and bottoms, with all intermediate space and pipes thoroughly covered. The pistons are all of cast steel coned. Each cylinder is supported by four cast-steel columns with cast-iron crosshead guides bolted on their face and standing on cast-steel main-bearing frames. The main-bearing caps are of forged steel with a brass bush, and, as the bottom boxes, are lined with white metal. Water circulating is provided through top and bottom boxes. There are two bearings to a crank.

The main valves are operated by Stephenson link motion, double bar links, with eccentric rods 6 feet 1 1-2 inches centers. The reversing gear consists of a direct-acting steam two-cylinder engine. The reversing shaft is 8 inches diameter, with cast-steel arms of 24 inches centers.

The connecting rods are 7 feet 8 inches centers, 7 inches diameter at fork end, 7 1-2 inches at crank end. Crank end has brass bushes lined with white metal, 16 1-2



Boiler Pressure	160 lbs.
Receiver H.P.	155 "
" M.P.	64 "
" L.P.	14 "
Vacuum	26.5 inches
Revolutions	106.5
I.H.P.	7400.

I.H.P. for the two Engines 15048

Boiler Pressure	160 lbs.
Receiver H.P.	158 "
" M.P.	70 "
" L.P.	15 "
Vacuum	26 inches
Revolutions	106
I.H P.	7648

Marine Engineering

INDICATOR CARDS TAKEN ON FORCED DRAFT TRIAL OF KASUGA.

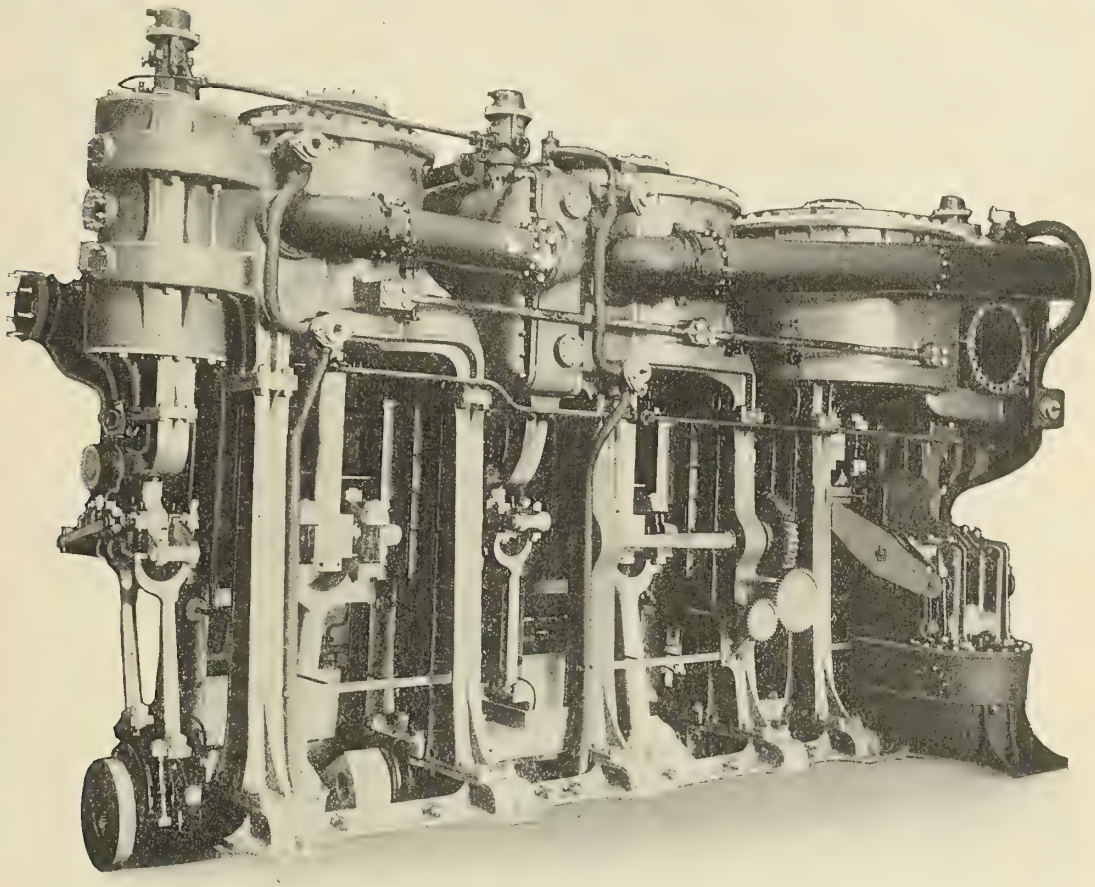
inches diameter, 19 inches long, while crosshead end has brass boxes each 9 1-2 inches diameter by 12 inches long. The slippers of crosshead are of cast iron, bolted to crosshead, faced with white metal and with astern surface two-thirds of ahead. The piston rods are 8 1-2 inches diameter in stuffing box, flat coupled in pistons, and tapered at cross head. Metallic packing is used for both piston and valve-stem stuffing boxes.

The shafts are of forged steel, hollow throughout, and the crank shaft is made interchangeable in three parts. The thrust shaft is 16 inches diameter, 50 inches long, with 7 collars 2 inches thick, 27 inches diameter. The thrust bearings are of cast iron with cast-iron horseshoes lined with white metal, and each shoe has water circulation, and collars of shaft also run in oil bath. Steady bearing is provided at fore end.

The tail shaft is 16 1-2 inches diameter, 65 feet over all, with brass sleeves for bearing, and covered with brass liners between the sleeves; the joints between liners being male and female with a white metal ring, calked. The total length of one line of shafting from forward coupling of the high-pressure cylinder to end of tail shaft is 164 feet. Steady bearing are of cast iron, lined on bottom with white metal, six on each line of shafting.

Each propeller is a true screw, three bladed, with brass hub and blades of the dimension indicated on the table. A complete oil and water system is provided extending to all parts of the main engines. The oiling is by wick feed, from brass oil boxes on cylinders for main moving parts, separate boxes being fitted for each main bearing and eccentric. Water circulation is provided for guides, main bearings, and trust-bearing shoes—sprays and pipes for all other parts, with a very complete system of cocks and swing joints. All piping is of brass.

The condenser is of sheet steel 3-8 inch thick, 6 feet 3 inches inside diameter, 9 feet 4 1-2 inches long between the tube plates. The heads are of brass. The circulating water is passed twice through the condenser, being supplied by a compound engine of 80 horse power. On the four preceding ships the condensers were of brass throughout the oval form.



ONE OF THE 3-CYLINDER, TRIPLE-EXPANSION ENGINES OF THE JAPANESE CRUISER KASUGA.

A large feed pump is fitted in each engine room capable to feed all the boilers at once; and an auxiliary water feed pump is in each boiler room, sucking from the hot well, from the water tanks, and from the sea.

Each vessel has four double-end and four single-end Scotch boilers that supply steam at 165 pounds gauge pressure. The boilers are arranged in two compartments forward and in two aft. Forced draft is applied to the ash pits. Air is supplied by twelve fans 5 feet diameter. The steam piping, which is of steel with cast-steel bends, comprises two main lines laid along each side of the vessel to the engine room, and so fitted that both engines may be supplied from one or the other line.

Feed-water heaters are fitted inside the boilers and are

of Pautrie type. The temperature of water was 260 degrees Fahrenheit when boilers worked at full power.

The steering engines are of Roger type and the stockless anchors are of the Hall type. The maximum coal supply of 1,100 tons will give a radius of action of 9,000 miles at 10 knots.

SPEED TRIALS.

The *Kasuga* had a dock trial on June 18, at which the engines were run for eight hours at 52 revolutions, half the time being supplied with steam from the forward boilers and the other half from the after boilers. On October 5, the *Nisshin* was given a similar trial. On July 22, the *Kasuga* was tried at sea under natural draft, off Genoa, the trial lasting six hours, and on October her sister ship underwent a similar trial. The full power trials were run on later dates. As the ships are similar and the results alike the data for only the *Nisshin* are given.

MARINE ENGINEERING DATA CARD. **MARCH, 1904.**

NAME—Kasuga and Nisshin. NATIONALITY—Japanese. TYPE—Armored cruisers.

LAUNCHED—1903. BUILDER—Ansaldo and Co. OWNER—Japan.

Length over all	357 ft. 0 ins.	Centrifugal, wheel diameter	48 ins.
" between perps	344 " 0 "	Engine	10 and 16 by 12 "
Beam, extreme	61 " 4 "	Feed pump	8 1-2 and 12 " 10 "
Depth	40 " 0 "	Condensers	two main, plate shell
Draft, mean load	23 " 3 "	Cooling surface, total	13,820 sq. ft.
Displacement	7,400	Two auxiliary, total surface	3,230 " "
Engines:	two triple-expansion	**Propellers:**	two 3-bladed
Cylinder diameters	42 1-2, 63, and 93 3-4 ins.	Diameter	16 ft. 8 1-2 ins.
Stroke	46 "	Pitch, mean	23 " 4 "
I. H. P., designed	13,500	" ratio	1.4
R. P. M.	100	Blade area, developed	76 sq. ft.
Speed, designed	20 knots	Material	manganese bronze hub and blades
Piston rods, diameter	8 1-2 ins.	**Boilers:** Scotch	four-double; four-single
Crosshead pins	9 1-2 diameter by 12 "	Diameter	14 ft.
Connecting rods, centers	7 ft. 8 "	Length	18 ft. 8 ins, 9 ft. 6 ins.
Crank shaft and pins, diam	16 ins.	Furnaces, mean diam.	45 ins.
" " holes	8 "	Number, each	6 3
Line " diam	15 "	G. S.	148 74
Holes, "	7 1-2 "	H. S.	4,006 2,003
Thrust and tail shaft	16 1-2 "	G. S., total	889 sq. ft.
Air pump	33 diam. by 21 "	H. S., "	24,036 " "
		Working pressure	165 pounds

TRIAL DATA. **MARINE ENGINEERING DATA CARD.** **MARCH, 1904.**

NAME—Nisshin. NATIONALITY—Japanese. TYPE—Armored cruiser.

LAUNCHED—1903. BUILDER—Ansoldo and Co. OWNER—Japan.

	Natural Draft.	Full Power.		Natural Draft.	Full Power.
Draft, forward	22 ft. 7 ins.		Vacuum, ins	28.3	28.5
" aft	23 " 11 "		R. P. M.	94.55	106.7
" mean, for each trial	23 " 3 "		Temp., deg. F., hot well	103	111
Displacement	7,400 tons		" " boiler feed	260	264
Wetted surface	27,325 sq. ft.		" " engine rooms	90	102
Immersed mid-section	1,218 " "		" " boiler "	86	94
Date of trial	Oct. 22, Nov. 6, 1903		Air press. under grate, ins		1 3-4
Duration	6 hrs. 100 min.		Coal consumed, lbs.	112,630	45,040
Steam pressure, steam pipe, lbs	165 162		Lbs. per I. H. P. per hr.	1.75	2.02
" " H. P. value, "	160 154.5		I. H. P., main engines	10,540	14,895.
" " M. P. "	66 61		Speed, knots	18.7	20.4
" " L. P. "	12.4 13.5				
M. E. P. in H. P. cyl., lbs	46.9 64.1				
M. E. P. " M. P. "	27.4 34.0				
M. E. P. " L. P "	12.7 14.5				
Cut off in H. P	.6 .75				
Opening of throttle	.5 .5				

Shipbuilding in Japan.—The Kobe Shipyard.

The rapid progress of the shipbuilding industry in Japan, achieved for the past ten years, is a well-recognized fact, as well as the expansion of her sea power, since the Japan-China war. Her present determined attitude toward Russia is only possible because of her strong military and commercial position resulting from a powerful navy, a prosperous merchant marine, and good shipbuilding facilities. Those who heard of the failure of building gun boats for the Philippine government, at the Uraga Dock Yard Company, are doubtful of the ability of shipbuilders in Japan. However, this company is by no means representative of Japanese shipbuilders. There are only two first-class yards, equipped for large work, in the country, one at Nagasaki and the other at Kobe.

The victory of Japan over China in the Japan-China war brought the Kawasaki Dock Yard Company of Kobe to a position of eminence throughout the Orient. The yard had been the government navy yard until May, 1886, when its ownership was transferred to Mr. S. Kawasaki, the late member of the House of Peers. During the last year the regular number of men employed varied from 3,000 to 4,000, and the yard is equipped with every kind of modern machinery, electric and pneumatic. While at present there are nine shipbuilding berths and a fine graving dock, 407.6 feet in length, 63.6 feet in width of the entrance, 23.9 feet in depth, the demand for work and repairs is so great that this company is contemplating the construction of much larger berths and docks.

Steel castings and forgings, which had been looked

upon as the most difficult undertakings in Japan, are also successfully made there.

As the company is practically the sole contractor to the imperial Japanese navy, many first-class torpedo boats have been constructed here. In regard to merchant work, many ocean-going steamers have been launched and are under construction by the orders of Japanese customers, Chinese, and Corean governments. In recognition of the fine equipment and output of this yard the Japanese government awarded this company the highest honorable medal at the Osaka Exhibition.

The training ship *Taisei Maru* was launched at Kobe last December for the Nautical College at Tokio, which shows their ability to build large steamers of this kind.

RUSSIAN BATTLESHIP RETVIZAN, REPORTED DAMAGED AT PORT ARTHUR IN THE FIGHT OF FEBRUARY 9. BUILT BY WILLIAM CRAMP AND SONS' SHIP AND ENGINE BUILDING COMPANY.

Length, perpendiculars, 374 feet 1 inch; beam, 72 feet 2 inches; load draft, 27 feet 3 inches; displacement, 12,700 tons. Belt, 9 inches to 4 inches; deck, 4 inches to 2 inches. Armament, four 12-inch R. F. G., twelve 6-inch R. F. G., eight 3-inch, twenty-four 3-pounders, six 1-pounders. Speed, 18 knots; I. H. P., 16,000.

[Photograph by E. Muller.]

The construction was specially arranged for sailing equipment as well as steam.

The vessel is a four-masted, full-rigged shipentine with auxiliary steam power consisting of two twin-screw, triple-expansion engines. The hull is 300 feet over all in length, 270 feet perpendiculars, 44 feet molded breadth, 26 feet 9 inches molded depth, 20 feet 10 inches draft, and of 4,300 tons displacement.

Notes on Method of Conducting Trial Trips in the German Navy.

The different navies have different methods of conducting the trial trips of their boats, and one characteristic of the Germans has been the thoroughness with which all undertakings are accomplished. As it was the writer's good fortune to be present at a trial trip of the latest German armored cruiser, *Prinz Friedrich Karl,* he had opportunity to observe the scientific and painstaking methods employed to obtain accurate and valuable results, and to note the comparison with American ways.

The scientific staff at the trial trip of the German warship was divided into three distinct branches, as follows:

1. The construction corps.
2. The engineering staff.
3. The general inspection board.

Each of these divisions had its own heads and worked independently of each other to attain the general common result. These government officials were again re-enforced by the shipyard officials, who, however, merely checked up results and did not take any actual

data, as that had been previously done at the builder's trial.

The trial trip was in charge of an official especially detailed as the head of the trial board who acted as referee in all matters wherein there was any dispute between the shipyard or government officials, but the regulations for running the trial trip are so exactly laid down and specified that these disagreements were only on minor points and could not in any way affect the results of the trial.

The trial was made in deep water, the course having been marked off with buoys, a double row of which were so placed that an accurate sight could be made on each one as the vessel passed. These buoys were placed at distances of about one-quarter mile, and a rowboat stationed at each one to keep it in position and also to make tidal corrections if necessary. Six runs each way over a five-mile course were made, the conditions being that the throttle should not be touched from the time of starting the trial until the time of finishing, and the readings of revolutions, steam pressure, indicated horse power, etc., were taken at regular intervals, including the time of making the turns. To make the turns usually occupied about fifteen minutes, as quite a distance below the course was always run, in order that as straight a line as possible could be steered; consequently plenty of room was given for heading the vessel in her course. Indicator cards were taken every five minutes on both top and bottom ends of the cylinders simultaneously, and with independent indicators placed at each end of the cylinders and a man stationed to take each card. These cards were then integrated and the areas plotted on a sheet; curves were then drawn and the whole curve integrated to find the total and mean area over the course. The revolution counter was read every five minutes, and in addition to the indicator cards mean pressure indicators were used as a check. Other readings taken were engine-room and boiler-room temperatures, temperatures of feed water, calorimetric readings of the moisture in the steam, receiver pressures, temperatures of steam at the receivers, temperature of the circulating water both at entering and leaving the condensers, temperature of the steam at entering the condenser and of the condensed water. Temperature of the feed water before and after entering the heater, the amount of steam necessary to heat the feed water, casing and up-take temperatures, and by means of a pyrometer the temperatures in the combustion chamber and stack were all recorded.

Having previously determined the initial friction of the engine from a shop trial, and the actual resistance of model from experiments at Kiel, a very close approximation of the actual efficiency of the driving mechanism was now determined. In addition a very exhaustive series of standarization runs were made under as nearly trial-trip conditions as was possible to obtain. These results were then plotted and if there was any discrepancy between the curves, showing that an error of observation had been made, the results were immediately discredited and another set of data taken.

Only the most experienced firemen, oilers, engineers, etc., are taken on these trial trips, and every possible means for insuring accuracy is adopted. Even calculations for wind resistance are made, barometric conditions, external temperatures, etc., are taken into account in order to as nearly as possible arrive at a result which can be compared with the model experimental results. The builders insist upon this, as the requirements laid down by the German admiralty are so exact and so little leeway is allowed that every possible precaution must be taken to insure accuracy. However, the results thus obtained are very nearly, if not always, of such character that they can be reproduced at any time under similar conditions. The aim of the German admiralty is not so much to have forced-draft, high-speed trials as it is to make certain that the conditions laid down have been fulfilled in a proper manner and that the contract has been complied with in every way.

The construction board meanwhile makes the most accurate determinations of the structural conditions of the boat during this trial, such as taking vibration data at various points, observing the workings of the rivets, and other structural details by means of the most careful micrometric determinations. After these speed trials are concluded, the vessel is put to every possible test involving strain upon the various structural members of the boat. These not alone include the hull and fittings, but also the structural conditions of the machinery, etc.

The engineering corps has only to do with the operation of the machinery, the construction corps being responsible for its strength, distribution, etc. The writer noticed between the gun and main decks arched stringers were worked through longitudinal and transverse members, and on inquiry learned that these had been put in to longitudinally distribute the strain from the gun platforms and sponsons. When he inquired why a distribution of the longitudinal members in the way of keelsons would not accomplish the same results, he was shown a strain diagram which had been worked out as a result of these trials, which conclusively showed that the only means of taking care of this strain would be through arched girders such as are used in pier bridges and which would carry off the strain to those members of the boat where they would do the least damage and offer the least resistance. Upon inquiring if the results obtained from these trial trips were given to the various shipyards it was learned that they are not made public in any shape or form, but held closely by the admiralty and used for reference in the design of another boat. A government official said that as the shipyards had been building a large number of boats for foreign countries, the government would not give them the result of these experiments for use in other navies, but the shipbuilder must take for granted the desirability of these structural details, which, when ordered, must be carried out.

Great stress was laid upon trim conditions during the trial. Exhaustive photographic reproductions were made to determine the squat and also wave formation. These were compared in turn with the photograph taken at the model experimental tank and any discrepancy investigated thoroughly. Accuracy to the point of which we have no conception in this country is in this wise obtained, and the admiralty is collecting a mass of information which is assisting them toward a development of some entirely new principles concerning ship construction, design, and propulsion.

A short description of the vessel may be of interest.

The *Prinz Friedrich Karl* is a steel armored cruiser, 394 feet long, 65 feet 6 inches beam, and at a mean draft of 24 feet 6 inches displaces about 9,000 tons. The vessel is fitted with three sets of engines driving triple screws. Each engine is in a separate water-tight compartment and is of the four-cylinder, triple-expansion type. Steam is supplied from Durr water-tube boilers, fourteen in number, in three water-tight compartments. The steam pressure is 225 pounds maximum, 210 pounds normal; the normal coal supply is 950 tons, the maximum coal supply being 1,500 tons, which will give the vessel a steaming radius at her most economical rate of speed of about 15,000 miles.

The armament consists of four 8.2-inch quick-firing guns, mounted in two turrets, one forward and one aft, protected by 6 inches of armor; ten 6-inch quick-firing guns, six in armored redoubts on the main deck and four in oval turrets on the upper deck between the 6-inch main-deck guns. There are in addition twelve 3.4-inch quick-firing, ten 1.4-inch, and four machine guns; four torpedo tubes, one forward and two on broadside, submerged, and one aft, above the water.

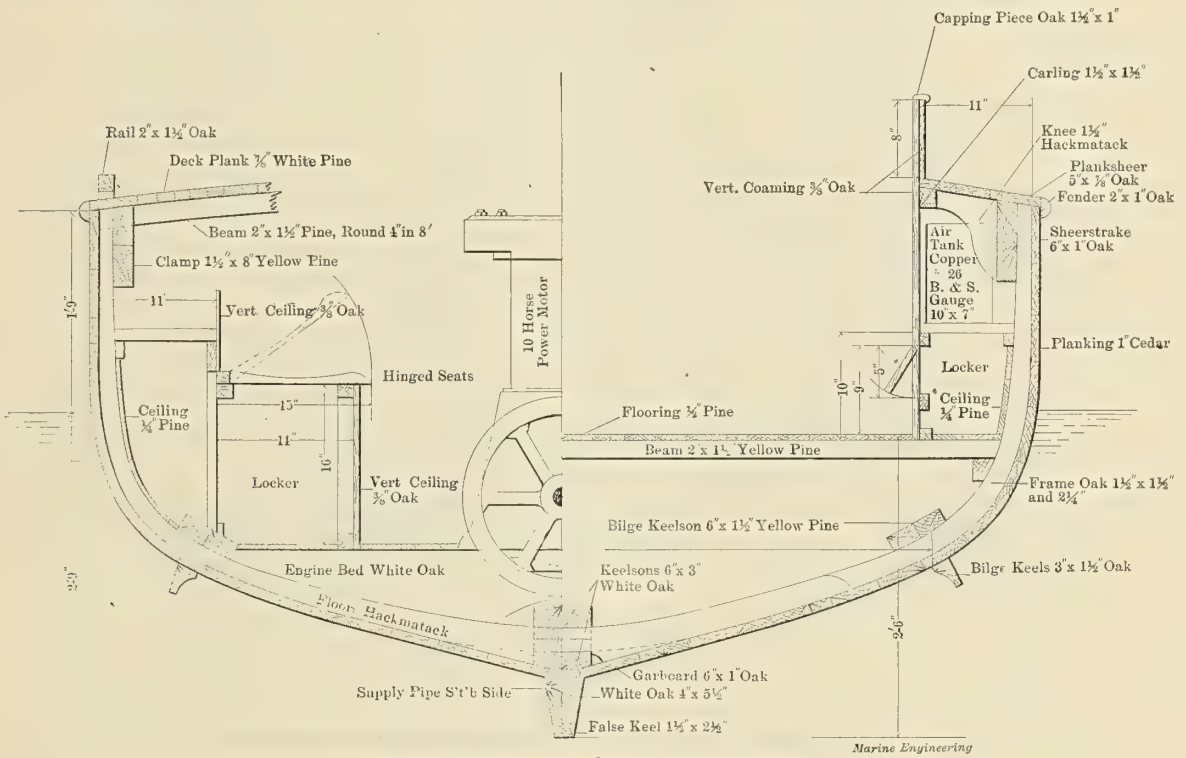
The protection is afforded by a complete water-line belt, 7 feet 6 inches high, 4 inches in thickness amidships, tapering to 3 inches at the ends. Above this there is a citadel of 4-inch steel extending for 164 feet amidships. The forward turret is raised one foot higher than the after turret, thus giving the vessel a large freeboard and good sea-going qualities. The crew numbers 550 men. With 17,000 I. H. P. a speed of about 21 knots was obtained on trial. This vessel is one of the *Prinz Heinrich* class, the first one of which was laid down in 1898.

Subscriber.

Design of a Cruising Launch.

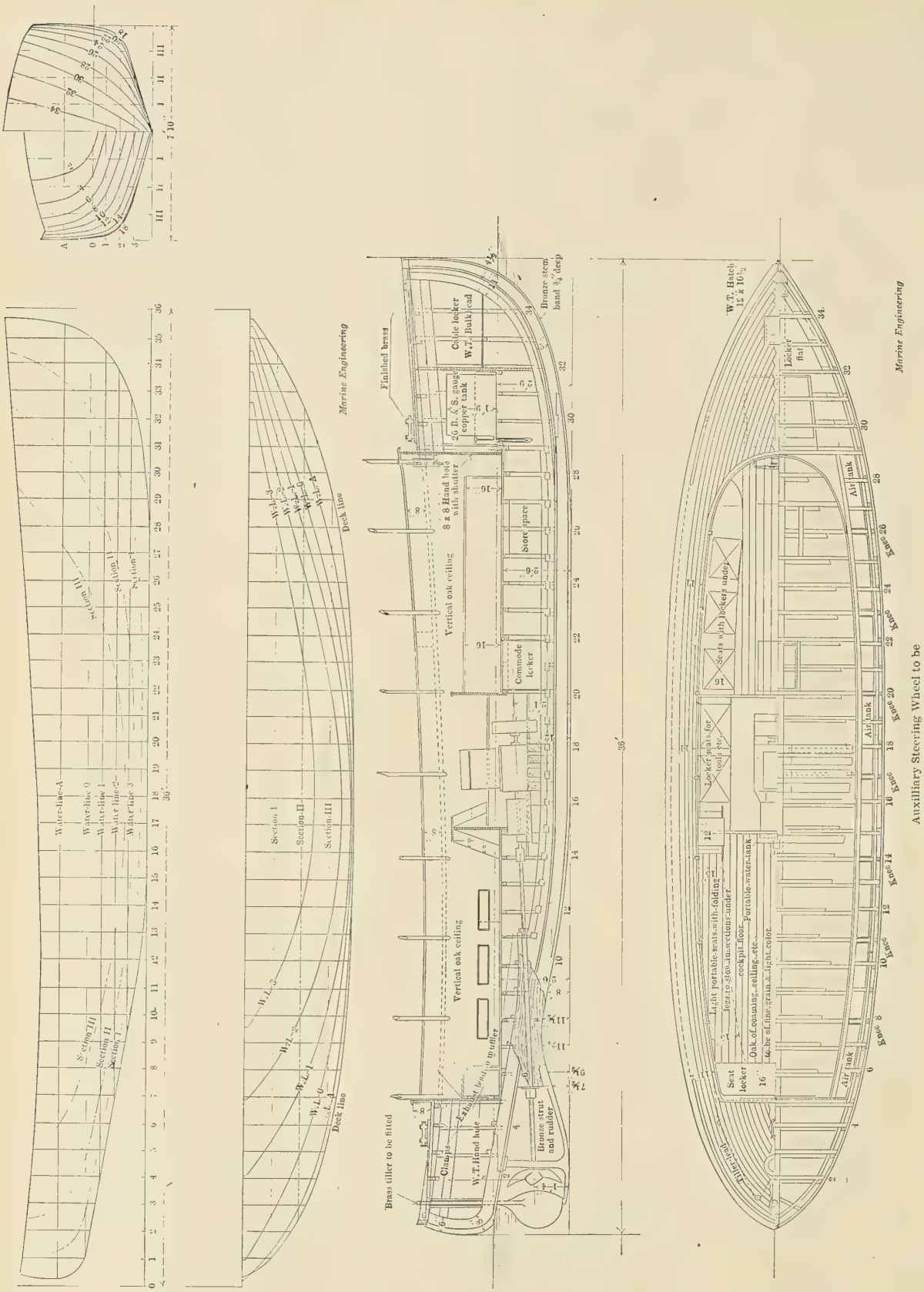
The plans of the powerful crusing launch published herewith were prepared at the offices of Messrs. John Macconnell, Jr., and George Crouse Cook, New York, N. Y., and the launch is now being constructed by the Poucher Company at City island.

The qualities required by the owner, Mr. W. A. Brown, for the launch, which is to be used about Shelter island and the lower reaches of Long Island sound, were seaworthiness, handiness, speed, and appearance; this design was therefore submitted and accepted as giving due consideration to each of these features. The dimensions finally selected were: Length over all 36 feet, length on water line 35 feet, greatest beam 8 feet, total minimum depth 4 feet 7 inches, load draft 2 feet 6 inches, corresponding displacement 12,000 pounds.


Capping Piece Oak 1½"x 1"
Carling 1½"x 1½"
Rail 2"x 1½" Oak
Deck Plank ⅞" White Pine
Knee 1½" Hackmatack
Planksheer 5"x ⅞" Oak
Vert. Coaming ⅜" Oak
Fender 2"x 1" Oak
Beam 2"x 1½" Pine, Round 1" in 8'
Air Tank Copper 26 B. & S. Gauge 10"x 7"
Sheerstrake 6"x 1" Oak
Clamp 1½"x 8" Yellow Pine
Vert. Ceiling ⅜" Oak
10 Horse Power Motor
Planking 1" Cedar
Hinged Seats
Locker
Ceiling ¼" Pine
Flooring ¼" Pine
Beam 2 x 1½ Yellow Pine
Frame Oak 1½"x 1½" and 2¼"
Bilge Keelson 6"x 1½" Yellow Pine
Engine Bed White Oak
Keelsons 6"x 3" White Oak
Bilge Keels 3"x 1½" Oak
Floor Hackmatack
Garboard 6"x 1" Oak
Supply Pipe S't'b Side
White Oak 4"x 5½"
False Keel 1⅝"x 2½"
Marine Engineering

MIDSHIP SECTION OF A 36-FOOT CRUISING LAUNCH.

The boat is broad and strong, with considerable freeboard and reserve buoyancy. The profile of the stern is of the so-called torpedo type, which is clean and dry in a seaway, and this, together with the full lines of the afterbody, will serve to keep the craft up when running hard. An open bronze strut carries the rudder and propeller, which allows the stern to be so cut away that the center of lateral resistance is well forward and the boat turns handily about a point approximately at the forward wheel. A note of the proportions will show the initial stability to be quite high, and it is, therefore, quite safe for a number of persons to sit upon the short forward or after decks for the purpose of fishing, etc. The question of speed was not of great importance in this craft and a guarantee of 10 1-2 miles in an hour's trial is all that is required. The propeller was designed to give this speed with a 30 per cent. slip, which is, for a



Auxiliary Steering Wheel to be fitted at frame 18 on starb'd side

LINES, INBOARD, PROFILE, AND DECK PLAN OF 36-FOOT CRUISING LAUNCH, DESIGNED BY GEORGE C. COOK.

craft of this type, quite large. The matter of safety was also one to which the owner asked no little attention, and, as a result, there are two watertight compartments at the ends of the boat and a series of copper air tanks fitted along the length of cockpit under the decks. These combined features will float the launch and a considerable load should the craft, by any chance, become swamped.

The arrangement of the launch is most simple and from forward aft consists of the watertight anchor cable compartment, the gasoline tank section, the forward cockpit with locker seats and storage space under the floor, the motor section with locker seats for batteries and general stores, the after cockpit with transverse locker seat and light folding side seats which are stowed under the floor, and finally the after watertight compartment containing the muffler, etc., which is reached by a screw manhole plate fitted in the deck.

The construction of the hull is strong and somewhat heavy, as desired by the owner. In fact, it closely follows the requirements of the standard United States Navy launches of corresponding size. The keel is of oak 4 by 3 1-2 inches, supported by an oak false keel; the keelson is made in two sections 3 by 6 inches each, extending from the stern to the shaft piece and morticed to allow the passage of frames and floors; the floors are of 2 1-4 by 1 1-2 inch hackmatack, 5 feet in length amidships and tapered toward the ends; the frames are of steam bent oak 2 1-4 by 1 1-2 inches at the foot and 1 1-2 by 1 1-2 inches at the head, spaced 12 inches centers to centers; the beam clamps are of yellow pine in two pieces 1 1-2 by 8 inches, morticed to receive the ends of the beams; bilge keelsons are each made from two pieces of yellow pine 1 1-2 by 3 inches and extend approximately the length of the cockpit; the deck beams are 2 by 1 1-2 inch pine with a round of 4 inches in 8 feet, and throughout the length of the cockpit a hackmatack knee is fitted in place of the partial beam; the sheer and garboard strakes are of oak 6 by 1 inch, while remainder of the planking is of 1-inch cedar not over 6 inches in width; the deck planking is to be of 1-inch white pine with 5 by 1-inch oak plank sheer; two watertight bulkheads are to be fitted of double diagonal planking with a layer of canvas between; the interior finish to be in a light grained oak made up with a vertical staving as shown.

The motor is of a 15 horsepower two-cylinder, four-cycle type, made by the Hasbrouck Motor Company, who guaranteed not only the power of the motor, but a speed above 10 miles per hour to the boat.

A 60-gallon copper gasoline tank is carried and the supply pipe to the motor is taken immediately outboard and led along the keel to the point of the vaporizer. The muffler is fitted immediately under the deck in the after compartment and the exhaust pipe opened just below the water line. At this point it may be interesting to note that actual experience with these motors has shown 15 to 20 more revolutions per minute with the exhaust below the water line than when above. The propeller is a four-bladed bronze casting of special design, with a pitch of 38 1-2 inches on a diameter of 26 inches, and an helicoidal area of 212 square inches, which will be turned between 450 and 500 revolutions when running at full speed.

31-FOOT CRUISING LAUNCH SURPRISE.

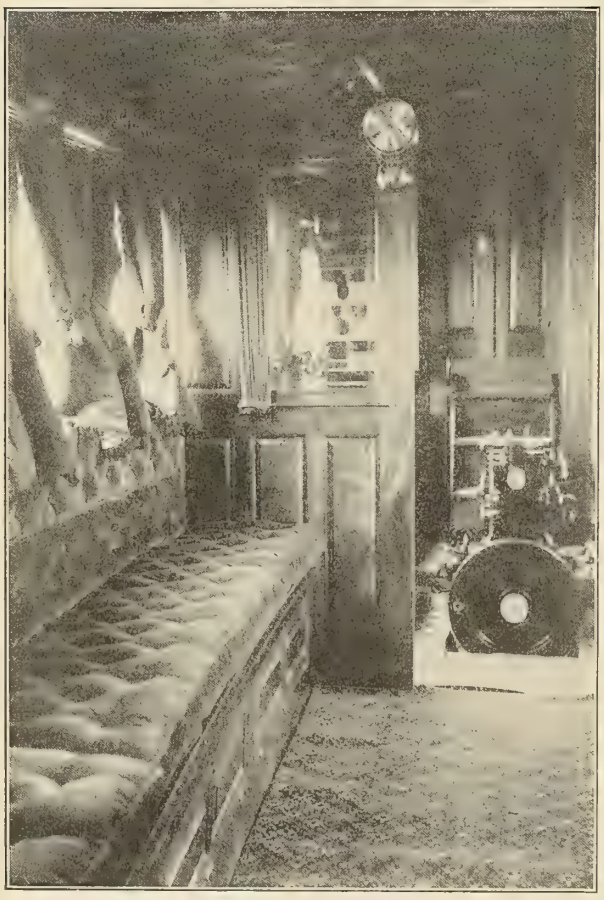
Cruising Launch Surprise.

The 31-foot motor boat *Surprise,* owned by Mr. R. W. Clemson, of Tarpon Springs, Florida, is, it is claimed, the handsomest power boat of its size in Florida waters. This boat was built from the Lozier Motor Company's design No. 3,108, Florida cruiser type, in the company's New York city shops, and was shipped to Florida by rail in December last.

The boat is 31 feet 6 inches long over all, and is built with the Lozier torpedo stern; on account of being designed for use in the shallow waters of the Florida coast, the draft is but 24 inches. The beam is 9 feet, being rather more than the average, but it makes the boat unusually roomy for its length. The entire cabin, interior and exterior, is of mahogany, and the appointments and furnishings throughout are unusually elaborate. The forward saloon is 13 feet long, providing four extension berths. On the starboard side aft of the main saloon is a brass-lined stove locker, containing two Kohtol stoves, and the top of the stove locker is a lid which can be raised when the stoves are in use. A

pull-out leaf adds to the convenience of the stove arrangement. Underneath the stove locker is a brass-lined locker for cooking utensils. Aft of this is an enclosed toilet with folding nickeled lavatory, Sands' water closet, plate-glass mirror, and mahogany brush, comb and soap racks.

On the bulkhead of the lavatory enclosure, in the engine-room, is a table locker, containing four mahogany folding tables, which are nested in a very small space. On the starboard side aft of the saloon is an extension berth for the engineer. This berth underneath is divided into compartments for ice chest and stowage



INTERIOR VIEW OF LAUNCH SURPRISE, LOOKING AFT.

spaces for engineer's supplies, etc. On the aft bulkhead is a mahogany rack for dishes and glassware.

The sliding door between the engine-room and saloon has beveled plate-glass windows, and on both sides of door in the bulkhead are also windows of French plate-glass. The gasoline tank is of 100-gallon capacity, and is in a water-tight bulkhead in the forward compartment, the fuel being carried to the engine outside of the hull.

The seats in engine-room and saloon, and the backs of seats, are upholstered to the windows with heavy tufted cushions. The saloon floor is laid with Wilton velvet carpet, and the engine-room floor is covered with linoleum. Mahogany shelf racks extend the full length of the saloon on both sides, just underneath the ceiling. The room is equipped with binnacle, ship's clock, fancy brass angle lamps, and handsome curtains are at all windows. Detachable brass-mesh mosquito screens are on all windows. Brass bands protect the stem and stern, and a heavy extension oak fender, capped by half-round brass, protects the boat when making landings.

The hull below the water-line is sheathed with 26-ounce copper. The machinery consists of a 10-horse-power double-cylinder two-cycle Lozier engine, with storage battery, a Lozier magneto, and an engineer's electric light.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports under date of February 9, 1904, the following degree of completion of vessels building for the United States Navy:

				Degree of Completion. Per Cent.	
BATTLESHIPS.				Jan. 1.	Feb. 1.
Missouri	18 knots.	Newport News Co.		99.9	99.95
Ohio	18 "	Union Iron Works		84.5	85.5
Virginia	19 "	Newport News Co		52.5	53.8
Nebraska	19 "	Moran Brothers Co.		35	37.7
Georgia	19 "	Bath Iron Works		42.5	45.4
New Jersey	19 "	Fore River S. and E. Co		49.43	50.3
Rhode Island	19 "	Fore River S. and E. Co.		50.61	51.7
Connecticut	18 "	Navy Yard, New York, N. Y.		26.7	28.5
Louisiana	18 "	Newport News Co.		34.5	37.55
Vermont	18 "	Fore River S. and E. Co.		2.76	3.6
Kansas	18 "	New York Shipbuilding Co.		2.6	3.9
Minnesota	18 "	Newport News Co		12	14.73
ARMORED CRUISERS.					
Pennsylvania	22 knots.	William Cramp and Sons		64.9	66.8
West Virginia	22 "	Newport News Co.		70.5	73.32
California	22 "	Union Iron Works		51	54
Colorado	22 "	William Cramp and Sons		69	71.8
Maryland	22 "	Newport News Co.		65.4	69.15
South Dakota	22 "	Union Iron Works		47	50
Tennessee	22 "	William Cramp and Sons		15.1	16.6
Washington	22 "	New York S. B. Co.		12	13.9
PROTECTED CRUISERS.					
Denver	17 knots.	Neafie and Levy		98	98
Des Moines	16½ "	Fore River S. and E. Co.		97	99
Chattanooga	16½ "	Lewis Nixon		72	72
Galveston	16⅜ "	Wm. R. Trigg Co		70.5	72
Tacoma	16½ "	Union Iron Works		99	100
St. Louis	22 "	Neafie and Levy		36.2	37.9
Milwaukee	22 "	Union Iron Works		41	42.5
Charleston	22 "	Newport News Co.		56.9	60
GUNBOATS.					
Dubuque	12 knots.	Gas Engine and Power Co.		20	25
Paducah	12 "	Gas Engine and Power Co.		16	22.2
TRAINING SHIPS.					
Cumberland	Sails	Navy Yard, Boston		12	25.5
Intrepid	"	Navy Yard, Mare Island		5	7
TRAINING BRIG.					
Boxer	Sails	Navy Yard, Portsmouth		6	10
TORPEDO BOATS.					
Stringham	30 knots.	Harlan and Hollingsworth		93	93
Goldsborough	30 "	Wolff and Zwicker		99	99
Blakely	26 "	George Lawley and Son		99	99
Nicholson	26 "	Lewis Nixon		99	99
O'Brien	26 "	Lewis Nixon		98	98
Tingey	26 "	Columbian Iron Works		100	
STEEL TUGS.					
Pentucket	12 knots.	Navy Yard, Boston		100	
Sotoyomo	12 "	Navy Yard, Mare Island		98	99

MARINE PROPELLERS WITH NON-REVERSIBLE ENGINES.*

BY RANKIN KENNEDY.

The introduction of internal combustion engines and steam turbines for marine propulsion requires the careful consideration of the fact that without some special contrivance these motors are not reversible.

The steam turbine when applied to larger vessels requires an auxiliary turbine for backing the vessel, and the high velocity of the screw propeller has been a matter for considerable experiment and one which has introduced new problems for solution.

This paper may, therefore, serve to direct attention to the consideration of other propellers than the screw, and to bring together various methods of employing the screw propeller for examination.

There are five systems whereby a vessel may be propelled and controlled when driven by a non-reversible motor:

1. By means of a screw propeller with movable reversible blades operated by a sliding rod through a hollow shaft. This is a favorite method for small craft.

2. By means of a screw propeller, and mechanical reversing gear usually in the form of friction clutches and spur wheels.

3. By two screws, a right and a left-handed screw, connected by a sliding rod through a hollow shaft, whereby either screw may be loose, and the other locked and driven, or both locked or loose.

4. By electrical control, the engine driving a dynamo and a motor driving the screw.

5. By water-jet propellers.

The writer then describes in more or less detail and illustrates the first four systems of propulsion, and then passes to the fifth heading, concerning which he states as follows:

The fifth and last system is not new, but has been used in vessels with some success. In this system the water jet propeller is adopted. This type of propeller has been discussed before in this Institution and perhaps prematurely condemned, but things have changed since then, and it may now be looked at from the non-reversible engine point of view, or with the high speed turbine as its motor power. In the early jet-propelled vessels the centrifugals employed to throw the jet were slow in speed, hence large in size, and not efficient. It may at once be admitted that the jet propeller has some well-defined limitations which will prevent it ever becoming a better propeller than a screw in large steam-driven ships employing reciprocating or other reversible engines. The column of water set in motion to produce the jet is limited in sectional area. In Ruthven's *Waterwitch,* built in 1867, the area of the jets combined was 6.28 square feet, equal to 1-53 of the midship section of the vessel, and the efficiency was 0.18. In Thorneycroft's hydraulic vessel, built in 1883, the area of jets combined was about one square foot, equal to 1-14 of the midship section, and the efficiency was 0.254. Efficiency depends to a large extent upon the sectional area of the jet being a very large fraction of the midship section.

The presence of a large volume of water on board the vessel is the chief drawback to the jet propeller. But by good design this volume can, however, be much reduced, for although the water must leave the vessel at a slow velocity in a large volume, it may pass along inside the vessel at a high velocity in a smaller column, and that is one feature to which I beg to draw your attention. A second point to which more attention should be paid is to the intake of water, for the vessel can be propelled by the suction of the pump as well as by the pressure.

In Thorneycroft's hydraulic vessels the suction intakes faced forward, so that the water entered freely with the motion of the vessel, and if the suction pipe were merely continued and led astern to an outlet, the vessel being towed, the water would flow with the speed of the vessel through the pipe, but the water would have no velocity relative to the still water outside the vessel. In Fig. 1, a diagram of a jet propeller, there is a clear passage for the water fore and aft through *A, C, B.* By means of a steam jet acting as in Morton's water lifter, the column of water can be set in motion, and by tapering the pipes it may pass quickly through the vessel as a small column, although it enters and leaves as a large column. Again, by arranging the proper size of the intake and outlet orifices, we might have a partial vacuum or suction at *A* and a pressure at *B,* both due to the impeller at *C*; and the thrust would be the sum of the forces acting at the suction and pressure orifices. It may be pointed out that in using a steam jet impeller at *C,* there would also be a reactive impulse due to the steam itself in the steam nozzle, for if the area of the steam jet orifice equalled 1 square inch, and the pressure of steam was 150 pounds, a useful effect or thrust of 150 pounds would accrue—which under ordinary circumstances is lost, and this in addition to the thrust due to the water. With some slight modifications this presents an ideal propeller, in which no engine with moving machinery is required. Although the jet propeller driven by a steam jet is not highly efficient, it may in some cases have counteracting advantages. It has one drawback when used at sea, and that is the condensed steam is lost. I need not dwell on the subject of steam jets (their inefficiency is too well known), but will pass on to the further consideration of the water jet propeller. Whatever impeller is used at *C,* there are some further points to observe.

In this simple arrangement the propulsion would be at *A,* due to suction; at *C,* due to the reaction of the steam, plus that due to the momentum of the water flowing away through *B,* outside of the vessel. To obtain the thrust of the pump due to its pressure, the water should be arrested somewhere between the pump and the outlet, so that it might flow away with the proper velocity, and produce an unbalanced pressure in the direction the vessel is to move.

The impeller was therefore made, in a recent case, to deliver the water into a pressure chamber, where its momentum was converted into pressure gradually, through cones, in the well-known manner of injectors. The water was discharged from the side of this chamber opposite in direction to the motion of the vessel. This gave good results, and is still under experiment.

*Abstracts from paper read before the Institution of Engineers and Shipbuilders of Scotland.

The impeller hitherto used has been a centrifugal pump. A diagram of this arrangement is shown in Fig. 2. The pump P delivers into a cylinder V, which, besides acting as a pressure receiver, also acts as a valve regulator whereby the vessel may be stopped, started, slowed, accelerated, or reversed by one lever without regard to the engine, which may run steadily on under a governor all the time. The valve V is made so that when it opens the forward nozzle N it closes the aft nozzle N_1, and when in the mid position, both nozzles are half open. By this means the flow of water is never violently checked, and high velocities of flow through the pumps can therefore be used. When the vessel has to stop for any considerable time, the engines are of course stopped.

This arrangement, it will be observed, is one suitable for internal combustion, and steam turbine engines which are not conveniently reversible.

As to the question of efficiencies, I am unable to give practically ascertained results of the five methods on any sufficient scale, but the theoretical results may be of interest together with the practical tests available.

In the Thorneycroft hydraulic vessel of 1883, the engine efficiency, *i. e.*, the brake horse divided by the indicated horsepower, was $\frac{\text{B.H.P.}}{\text{I.H.P.}} = 0.77$, the pump efficiency was 0.46, and the jet efficiency 0.71, which gives a total efficiency of 0.251. The remarkably low pump efficiency is surprising, and no less the engine efficiency. These figures were given as results of tests by Mr. S. W. Barnaby before the Institution of Civil Engineers.

Engines and pumps can now be obtained to give better results. Last year Mr. Konrad Andersson read a paper before this Institution, in which he stated (Table III.) the efficiency of the de Laval turbine pumps to be as high as .75 and .8. In the same paper the pounds of

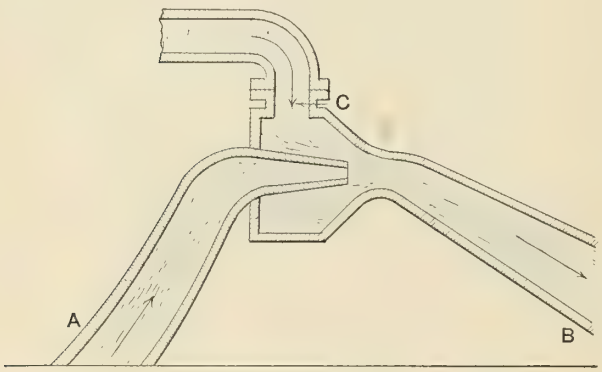


FIG. 1.

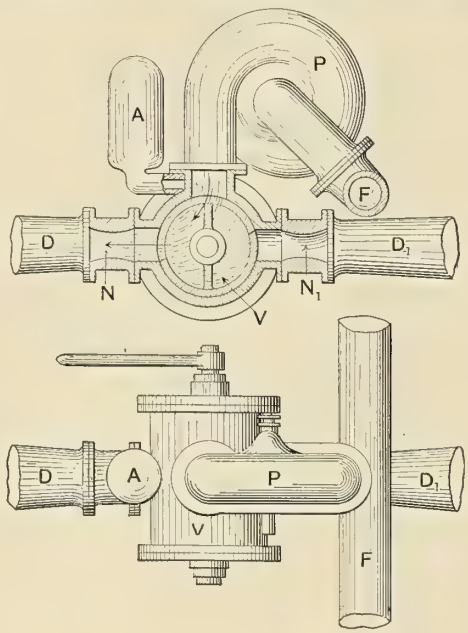


FIG. 2.

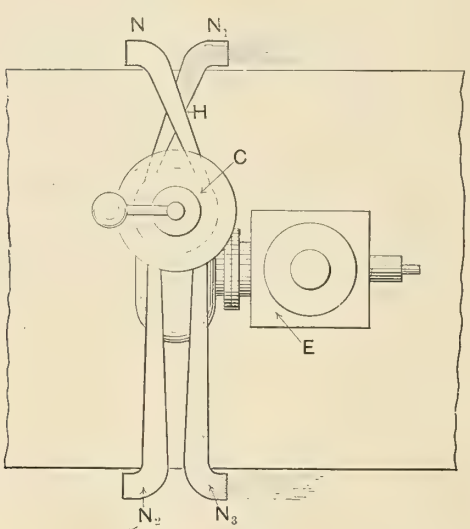


FIG. 3.

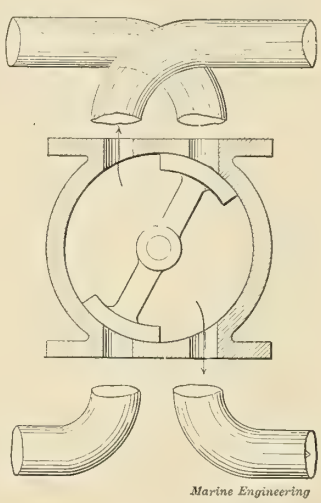


FIG. 4.

steam per brake horsepower are given, and in Table VI. the pounds of steam consumed per water horsepower are stated to be from 29 to 34.2 per hour. Taking the efficiency of the pump and engine at 0.75, and the efficiency of the jet at 0.66, then a total efficiency of 0.498 is quite possible on a consumption of steam upon the jet equal to 31 pounds per horsepower hour.

The jet propeller obeys the same law of efficiency as the screw propeller, namely—

$$\frac{V}{V + \frac{s}{2}}$$

where V = the velocity of the ship in feet per second and s the slip.

Assuming a speed of 20 feet per second for the ship and the same for the slip s, we get $\frac{20}{20 + \frac{20}{2}} = 0.66$ efficiency of the jet. The thrust would be equal to the area of the throat multiplied by the water pressure. The total reactive pressure would be that due to the velocities added, *i. e.*, 40 feet per second, and the head H would be $\frac{V^2}{2g} = \frac{40^2}{64.4} = 24.8$ feet, and the pressure due to this head = 10 pounds, nearly, per square inch. Hence an area of one square foot of nozzle would give a thrust of 1,440 pounds and the quantity of water delivered would be equal to the velocity multiplied by the area of the nozzle in feet $40 \times 1 = 40$ cubic feet per second = 2,500 pounds of water. This conclusion demonstrates the large volume of water required.

By an easy calculation the horsepower in the water in this case would be 90, and the engine indicated horsepower probably about 200.

Figure 3 illustrates in plan a form of jet propeller connected to an oil engine. The pump delivers into a vertical cylinder called the pressure chamber, shown in Figs. 3 and 4. Fig. 3 is a plan showing the delivery nozzles, N, N_1, N_2, N_3, two for going astern and two for going ahead. The pipes on one side of the boat are crossed in order to obtain a simple balanced valve for controlling the jets. This valve is shown in Fig. 4. It will be seen that either pair of tubes or jets may be opened or closed at will, and that the whole four nozzles could never be closed at once, the flow of water from the chamber being constant.

By making the valve in C double, the nozzles can be closed as desired and the boat steered by this same valve, and the pipes to the nozzles need not be in this case crossed as at H. Whatever the pressure in the chamber may be, the pipes are expanded towards the discharge, so that at the nozzle the absolute velocity of outflow does not exceed the maximum speed of the vessel.

After the discussion the author refers to the reversing internal combustion engine and describes in detail the Berthau engine, which was given in substance in Marine Engineering for December, 1903.

European Turbines.—Rear Admiral Geo. W. Melville and George Westinghouse have made a tour of inspection of the steam turbine works of Europe.

Scarfing a Bar Stem to a Plate Keel.

It may be for considerations of carrying capacity on draft, but more often for no special reasons, other than those dictated by personal opinion, that when owners and builders are planning the construction of modern passenger or cargo vessels, they increasingly favor the flat plate type of keel construction.

As usually constructed, this consists of a flat strake of plating similar to, but thicker and usually narrower than, an ordinary strake of shell plating on the same vessel, laid horizontally, upon which the vertical keel plate is fitted and connected by means of double angles. The scarfing of the rectangular bar stem and stern posts to such a type of keel was accomplished by shaping the lower portions of the stem and sternpost forgings to follow the contour of the frames so that the knuckle line formed by the flanged shell plates landing on the vertical face of the stem, dies out under the forefoot into the outside line of the plate keel without any unfairness; for the purpose of making provision for efficient riveting the inner surface of the forging at the lower extremity was scooped out.

In later vessels the lower extremity of the stem was made thinner and wider, and scooping was omitted.

In large modern vessels the lower part of the stem is often made a steel casting, scarfed to the upper part, which is the usual wrought-iron bar stem; the stern posts are now usually made cast steel. These castings are molded to conform to the shape of the ship in wake of the scarfs and in agreement with the lines plan thereafter, and to provide room for driving all the rivets possible, as tap rivets are objectionable, especially in the sternpost.

The purport of this note is to illustrate another method of scarfing a bar stem to a plate keel, as shown by the accompanying drawings.

This method has been practised for some years by two or three reputable shipyards, and some well-known transatlantic liners have their stems thus scarfed to the plate keel.

Fig. 1 shows a profile view of the part affected, the garboard strake of shell plating being removed from the starboard side; Fig. 3 is a plan of the continuous vertical center plate butted against the after side of the water-tight bulkhead on station No. 212; it is offset on the forward side in order to lap on the side of the bar stem, and is fitted in short lengths between the floors, for No. 212-217, where it ends.

Figs. 2, 4, and 5 are for the purpose of elucidating Fig. 1, and call for no remark except that they are drawn looking forward.

As will be seen by inspection, this scheme consists in carrying the rectangular bar stem to the fore peak bulkhead, the off-center intercostal vertical keel plates being lapped and riveted to the after end.

The flat keel plate is carried forward to the lap butt shown on Fig. 1, and wrought to the shape of the hull at the molded keel line to frame station 214, being thereafter knuckled from the bottom edge of the bar stem at No. 214 to the top edge at No. 216, and from there forward are the shell plating flanges against the stem in the usual way. The number of rivets fastening the plate keel to the stem reaches the full number usual

only at the extreme forward end, between frames Nos. 216-217; from there the number gradually diminishes, vanishing at No. 214. The plate keel is not connected directly to the stem from No. 214 aft to No. 212, but indirectly through the frames, floors and intercostal vertical plate. The part of the plate keel coming on the face of the stem is tap riveted at No. 215, one tap only being necessary to provide a calking edge; and from there forward is cut away.

The sizes of stem bar, rivets, and clips are given for the purpose of indicating the proportions of the parts affected. The advantage of this scheme of stem scarfing, as compared with the others mentioned previously, are of equal efficiency, combined with lower cost, due to

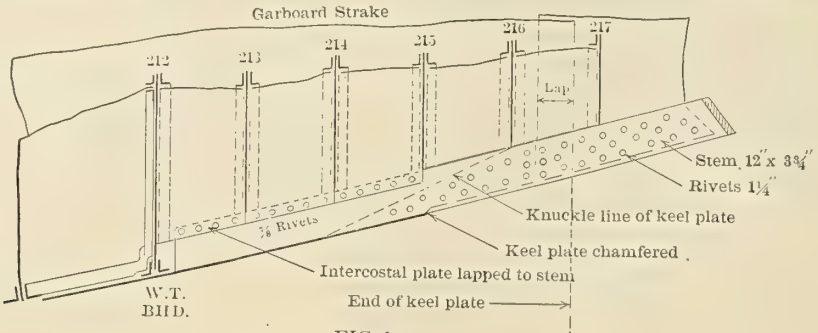


FIG. 1

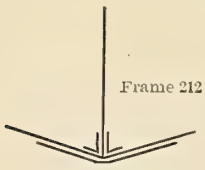


FIG. 2

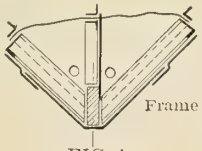


FIG. 4

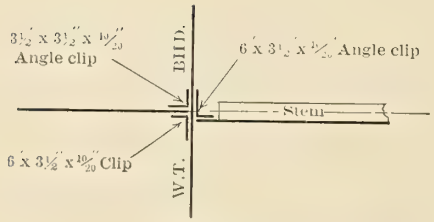


FIG. 3

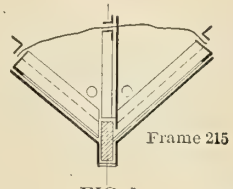


FIG. 5

Marine Engineering

METHOD OF SCARFING A BAR STEM TO PLATE KEEL.

there being no special forging with the requisite molds and patterns; the cost and difficulty of obtaining good steel castings are grave sources of dissatisfaction in shipbuilding economy, rendering their use undesirable.

The only disadvantage worth naming is the fact that the entrance of the hull at the part shown by Fig. 1 cannot properly be termed fair, because of the knuckle line of the plating suddenly dropping from the top edge to the bottom edge of a 12-inch keel in the short distance of two frame spaces; but this has an adverse effect on the appearance to a very small extent; how much depends greatly on personal knowledge and opinion of the critic. K. D.

New Steamship Baltic.

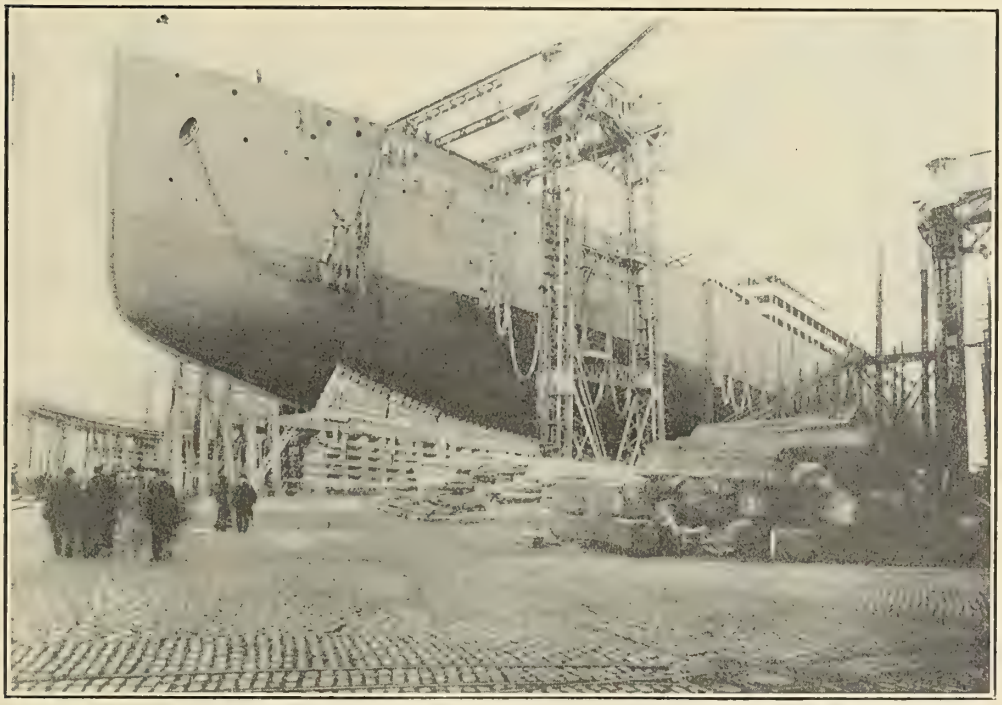
The steamship *Baltic*, now fitting out at the Harland and Wolff yards, Belfast, for the White Star Line of the International Mercantile Marine Company, is to be the largest vessel in the world, marking a decided step toward the thousand-foot ocean liner that already is predicted. She was put into the water November 21, the vessel being released from the stocks by a hydraulic ram, and the launch being successfully accomplished in one minute. The dimensions of the *Baltic*, which in general plan is a sister to the *Celtic* or *Cedric* of the same line, are: Length, 725 feet 9 inches; beam, 75 feet; depth, 49 feet; gross tonnage, 24,000. She will have a cargo capacity of 28,000 tons, and her displacement at load draft will be about 40,000 tons.

Accommodations are provided for about 3,000 passengers and a crew of 355, and in all classes the arrangements are according to the most modern standards, showing an improvement over even the most recent White Star ships, which have been regarded as the finest type of ocean liner. The first-class smoke-room and library will be on the upper promenade deck and the staterooms on the two decks below. The second-class accommodations will be directly aft of the first, and the third still further aft and to a limited extent forward, staterooms accommodating two, three and four persons being a special feature of the latter class. The dining saloons will be especially commodious and comfortable, and all the bathrooms and sanitary appliances of the most approved design.

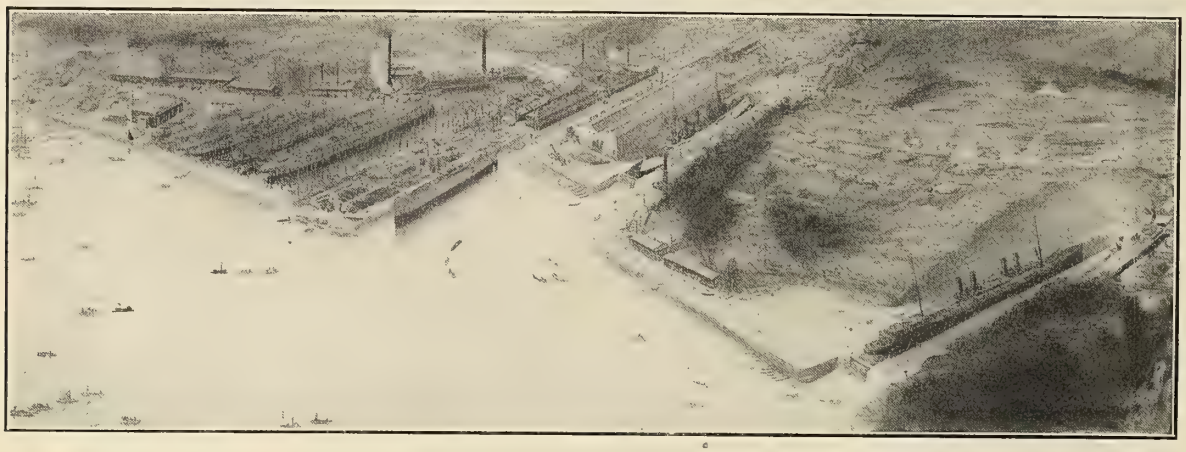
The decorations will be of the most striking and artistic kind. The dining saloon, extending the full width of the ship on the upper deck, will be perhaps the most magnificent on the Atlantic, the domed skylight being a particularly impressive feature of the decorative

scheme. The first-class smoke-room and library are similarly handsome apartments, and the second-class public rooms are in corresponding taste. Besides the ordinary staterooms, the new vessel will have an unusual number of suites, and several single-berth staterooms will be provided. The heating and ventilating of the ship follow the most modern practice and are most complete in detail.

The *Baltic's* holds will include refrigerators for chilled beef, and are provided with the most efficient machinery for loading and discharging cargo. Her engines will be of the quadruple expansion type, about 13,000 I. H. P., built on the balance principle, to reduce vibration. A speed of 16 1-2 to 17 knots is required, while twin engines and twin screws reduce the danger of disabling accidents to the minimum. The ship will probably be ready for the summer service between New York and Liverpool.



STEAMSHIP BALTIC, FOR THE WHITE STAR LINE, LAUNCHED FROM THE YARDS OF HARLAND AND WOLFF, BELFAST.



BIRD'S-EYE VIEW OF THE MITSU BISHI

THE MITSU BISHI DOCKYARD AND ENGINE WORKS, NAGASAKI, JAPAN.

The Akunoura Engine Works were founded at Nagasaki, Japan, by the Shogun government about 1856. Dutch engineers were employed and necessary machines and gear for commencing the business were imported from Holland. In consequence of this it is often noticed that a few old hands in the works still use the Dutch terms for some of the machinery. The jetty on which now stands the sheer legs were constructed at that time by means of a clumsy diving bell of Dutch make, which implement still remains at a corner of the works, in memory of the pioneers. At first the works were only on a very small scale, for repairing small steamers owned by the Shogun. About ten years later they were handed over to the superintendency of the present Meiji government, by whom great improvements were made. A large dry-dock at Tategami, now called No. 1 Dock, was constructed, and the patent slip at Kosuge, then owned by a British merchant, was purchased, and the business becoming gradually established, a steamer named *Kosuge-Maru*, of 1,500 tons gross was built of wood, as a forerunner of the shipbuilding in this island empire.

In 1884 the ownership of the whole works was passed from the government to the present proprietors, the Mitsu Bishi Company, and three years later the first iron steamer, of about 205 tons gross, was built, followed by three steel steamers, each about 700 tons, and also a steel steamer of 1,592 tons.

The following is the list of the principal vessels built at this yard since 1898:

Ship's Name.	Gross Tonnage.	I. H. P.
T. S. S. Hitachi-Maru,	6,172	3,888
T. S. S. Awa-Maru,	6,309	4,112
S. S. Miyajima-Maru,	1,592	890
S. V. Tsukijima-Maru,	1,519	305
(With auxiliary engines.)		
S. S. Tategami-Maru,	2,691	1,774
S. S. Akunoura-Maru,	1,717	1,340
T. S. S. Tahung-Maru,	2,243	2,242
S. S. Yenoura-Maru,	645	436
T. S. S. Kaga-Maru,	6,301	5,411
T. S. S. Iyo-Maru,	6,319	5,106
S. S. Oura-Maru,	712	700
S. S. Wakamatsu-Maru,	2,774	2,279
T. S. S. Tachang-Maru,	2,711	2,495
S. P. Dredger "No. 2 Dokai-Maru,"	495	400
S. P. Dredger "No. 3 Dokai-Maru,"	495	400
S. S. Daiya-Maru,	2,795	2,366
Steam Yacht Hatsukaze,	80	220
T. S. S. Aki-Maru,	6,443	5,448
S. S. Chefoo-Maru,	1,933	1,565
S. S. Niigata-Maru,	2,183	1,577
S. S. Yeiko-Maru,	1,966	1,963
S. S. Nikko-Maru,	5,400	6,500

H. I. J. M. Ss three torpedo boats, one 120 tons, the other two each 82 tons in displacement, were built, the material being given by the government.

Besides these, many smaller crafts of various types between 200 and 300 tons and a large number of steam launches were built.

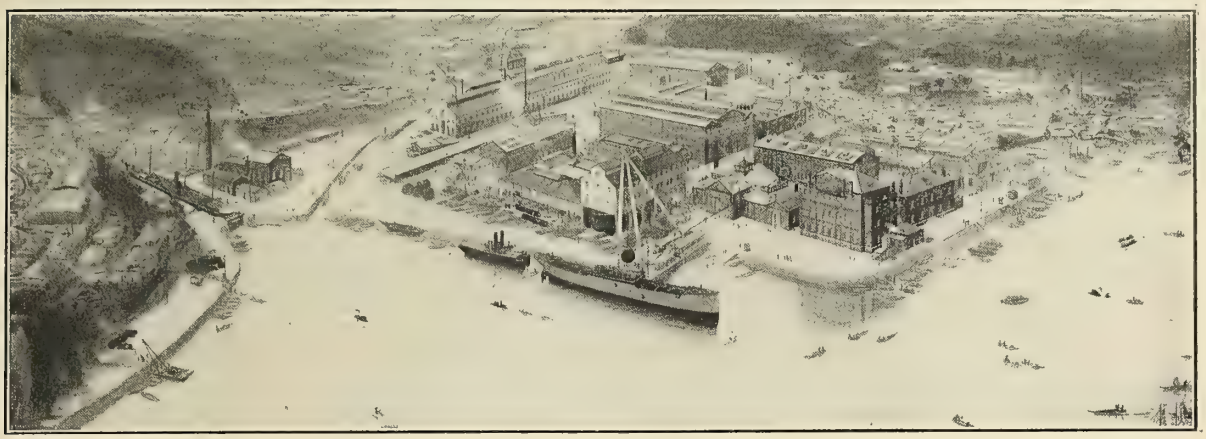
The works have of late been very much improved by extensions, new buildings being erected and large additions made to the machinery, all of the latest type, the premises covering at present about 80 acres.

The following will give a good indication of the capacity of the works: One pair of tripod steel shear legs of 100 tons capacity on the jetty for landing or shipping of heavy boilers and machinery, the depth of water under the shear legs being 25 feet.

BUILDINGS.

A machine shop has been lately built fitted with one 20-ton, one 15-ton, and two 5-ton overhead traveling cranes electrically driven; over 40 of the newest type of machines of various description, some of which deserve special mention, and include: a planing machine to plane 21 feet horizontally and 18 feet vertically; 54-inch center crank shaft lathe; 30-inch center gap lathe, the height of center in gap being 6 feet 6 inches; two lathes 22 inches centre shaft lathe, having a common center line to turn 67 feet in maximum length; one 5 1-2-inch spindle double universal horizontal drilling, tapping, boring, studding, and milling machine to move 10 feet vertically and 15 feet horizontally, and a cylinder boring machine to bore out cylinders up to 100 inches diameter.

The boiler shop has of late been extended and many machines added, including electric shell drilling machines, one 40-ton electric traveling crane, one 40-ton



DOCKYARDS AND ENGINE WORKS, NAGASAKI, JAPAN.

hydraulic crane, and also one 105-ton hydraulic riveting machine; also a plate roller which rolls a plate up to 2 inches thick by 11 feet 9 inches wide.

The blacksmith shop is furnished with eight steam hammers, ranging from 50 pounds to 7 tons, with sufficient hearths, furnaces, and cranes, etc., which enable the works to undertake any forgings up to 15 tons.

The foundry has lately been greatly extended and is capable of turning out iron casting of 50 tons, if necessary, in one casting. In the central building there are two electrically-driven overhead traveling cranes whose combined lift is 50 tons, and besides these five 3-ton swinging cranes in the wing.

The erecting shop is of ample size, fitted with overhead traveling cranes, one of these being 30 tons in capacity.

An electric shop is also installed with ample plant to execute electrical repairs, etc.

ELECTRIC POWER INSTALLATION.

Steam as a motive power has been superseded by electricity, which is now being used on a very extensive scale throughout the works, not only for lighting but also for driving machinery.

The Akunoura power house has been extended and equipped with two 25-Kw. Edison shunt dynamos, one 35-light Brush arc dynamo, and two new sets of 225-Kw. compound dynamos of the General Electric type, coupled direct to McIntosh-Seymour vertical cross-compound engines, have been lately added. At Tategami a new power house has been built, furnished with two 100-Kw. Seimen compound dynamos coupled direct to William's central valve compound double-crank engines, and one 25-Kw. shunt dynamo.

The Tategami shipyard, including joiner shop, saw mill, carpenter shop, galvanizing shop, machine shop, blacksmith shop, and molding loft, etc., has been greatly extended and improved, and is now capable of turning out ships of a gross tonnage of over 20,000 in one year. It has eight building berths ranging from 700 feet to 170 feet; all departments are well laid out with rails, turntables, portable cranes, etc.

Pneumatic tools have been tried on a small scale, as an experiment, and are to be installed at Tategami works generally.

DOCKS AND PATENT SLIP.

The works are equipped with two stone built dry-docks and one patent slip. Besides these, one very large dry-dock is in course of construction, which is now very nearly completed.

The following are the particulars of the docks and slip:

Name of Docks or Slip.	Length of Keel Blocks.	Breadth at Entrance		Depth of Water on Blocks at Ordinary Spring Tide.
		On Top.	On Bottom.	
No. I. Dock....	510 ft. 0 ins.	89 ft. 0 ins.	77 ft. 0 ins.	26 ft 6 ins.
No. II. Dock...	350 " 0 "	66 " 0 "	53 " 0 "	24 " 0 "
No. III. Dock..	714 " 0 "	96 " 7 "	88 " 7 "	34 " 6 "

(The No. III. Dock is in course of construction.)
Patent Slip.—Length of rail, 750 feet; width of rail, 30 feet. The slip is capable to take up ships up to 1,000 tons.

The company also own a salvage steamer of 712 tons and 12 knots speed specially built for the purpose, fitted with all the necessary pumps and gear of the most powerful description; a large number of experienced workmen and divers are always ready at short notice to undertake salvage operations.

SCHOOL, HOSPITAL, AND BENEFIT ASSOCIATIONS.

The works' school, which has been opened four years, has an accommodation for five classes totaling 250 boys each year, allowing 50 new candidates to enter and 50 graduating, but at present it is attended by 218 boys divided into five classes. This institution is free to the general public through the generosity of the owners of the works.

The yard has its own hospital for wounded to accommodate about 50 patients, in which men are treated at the expense of the company. The company has also its own water supply for the daily use of the works and for fire service, the reservoirs containing about 15,000 tons of water. The number of workmen employed is from 5,000 to 5,600 daily on pay sheets.

For the benefit of the workmen there is an institution called the Shokko Kyugo Ho, enforced since the end of the year 1897 with satisfactory results. This institution is based upon the principle of an assurance system,

each employee contributing a certain proportion of his wages on each pay day to which the employer contributes a like amount. The benefit accruing to the workman varies from 50 to 2,500 yen (a yen is equivalent to about 50 cents), according to class and rate of wages, and this is applied to the families of those who have died of wounds received on duty, to those incapaciated through injury received at work, and to those who, retiring from old age or other reasons, are entitled to receive pensions from this fund according to their grade of work.

To encourage thriftness amongst the workmen a savings-bank system was formed and put in force on October 1, 1902. The system requires, first of all, that one "kuchi," or a deposit of one yen, shall be made by each depositor on each pay day, and this amount is kept in a separate account, and when the amount of the principal and interest shall have reached 300 yen the savings for one "kuchi" is expired, and 50 yen extra to each 300 yen will be given as an encouraging subsidy or bonus.

In conclusion it should be stated that the capacity of the works is ample to undertake any repairs or to dock any vessel afloat; for this purpose a large supply of materials of every description is always kept in stock. Further improvements and extensions are to be carried out both at Akunoura and the Tategami, which, on completion, will still further add to the present capacity.

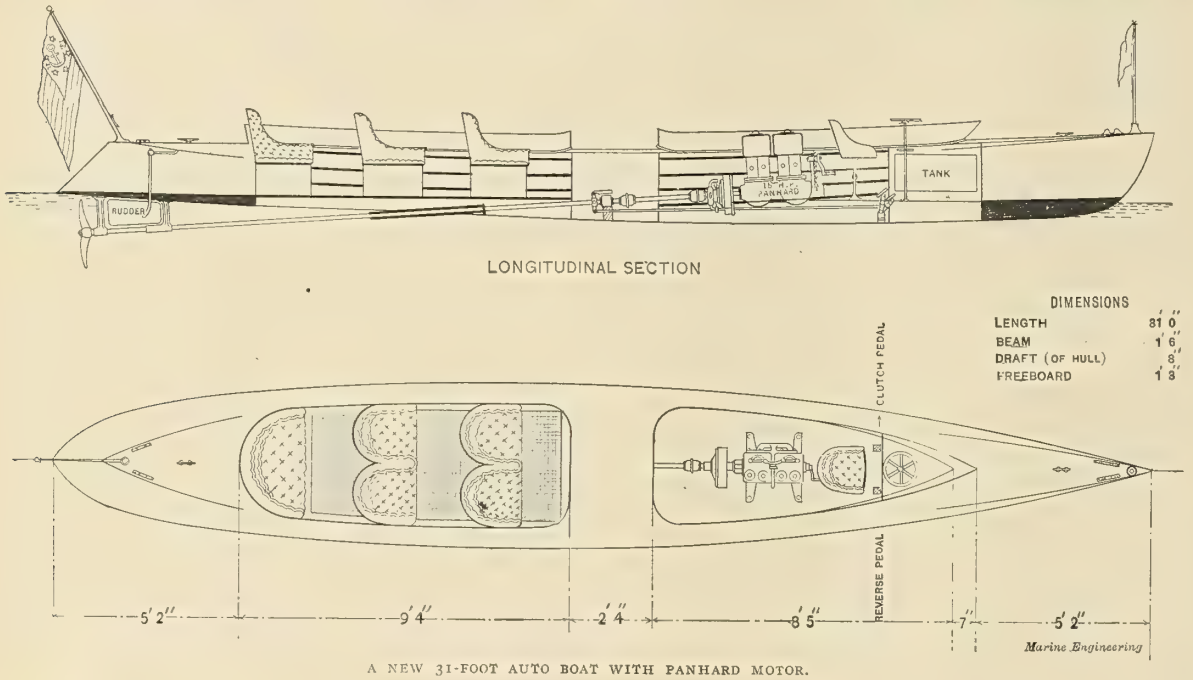
On another page of this issue will be found a description and illustrations of one of the newest steamships now under construction at this famous yard.

Naval Hospital.—Secretary Moody has written the House naval committee urging that Congress appropriate funds for the construction of a naval hospital at Yokohama, Japan.

Construction and Possibilities of the Auto Boat.

BY HENRY R. SUTPHEN.

The requirements of the typical auto boat, which is now being developed in this country, have necessitated a marked advance in hull construction. Last year several boats of this type were built at the works with which I am connected, both from designs prepared by outside naval architects and by the drawing-room force of the boat yard. Among the boats built from outside designs was the tender of the cup defender *Reliance,* which was one of the first light auto boats turned out in this country. The details of construction of these boats seemed at the time they were brought out to be the very lightest in weight of material that it was possible to build, but the success which they attained and the strength that they proved to have in actual service warranted the designers in going a step further, so that the boats to be turned out by this yard this season will have still lighter hulls; in fact, the lightest that it is probable have ever been built in this country.



A NEW 31-FOOT AUTO BOAT WITH PANHARD MOTOR.

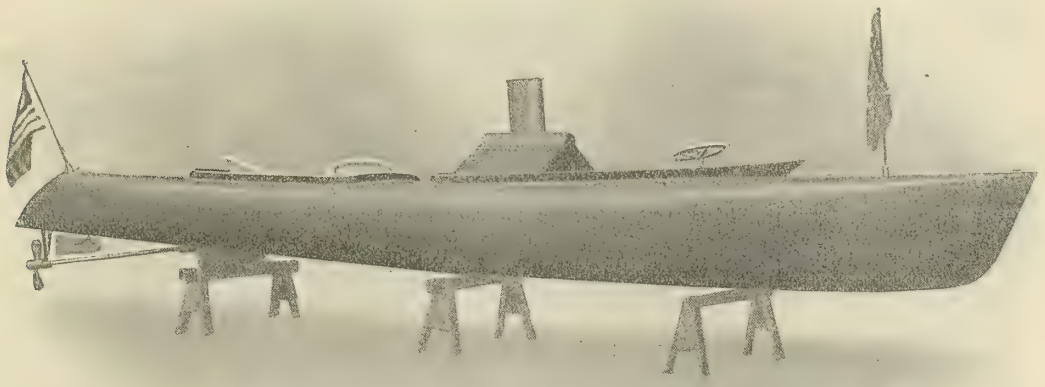
Among these new boats is one to the order of the Panhard Company, herewith illustrated.

To reduce weight of these shells, very light selected oak frames with very light plank keel are used, and in the smaller boats longitudinal frames with double planking are adopted. In the Panhard boat the finished thickness of the double planking is less than 5-16 of an inch. This hull, without machinery, weighs only 471 pounds, while the total weight of the boat equipped with an 18-22 horsepower engine and tanks is 1,060 pounds, which figures out that 1 horsepower is obtained for every 48 pounds of loaded weight. In the best automobile practice of to-day the ratio of horsepower to loaded weight is 1 to 85.

The Panhard engine which is installed in this boat was received a few weeks ago from Paris. The engine

is a complete unit in itself, being equipped with the builders' latest devices for vaporizing the gasoline in the Krebs carburettor; the latest improvements for lifting the gasoline to the engine by means of compressed air, and with the latest electrical-sparking apparatus, which enables the engine to be started up without the use of electric batteries, for the current for sparking the gas is derived upon the turning of the crank from the magneto. This is a decided advantage for boat work, as it eliminates all exposed electric wiring and complications with the electric batteries, which are hard to keep in order on a boat.

The muffler of the engine is on top of the cylinders, and a neat metal hood covers the top of the engine, and on top of this a small smokestack is placed to carry off the gases, which is plainly shown in the picture and which makes the boat look very unique.



31-FOOT AUTO BOAT WITH PANHARD MOTOR.

From past experience I believe the fastest auto boats, especially those of small size, are those lightest built and the ones equipped with foreign-built high-grade engines. There is no doubt but that the boat which is to win the race will be the one that has the lightest shell, with, of course, fair lines and a light, reliable motor. The light hulls, above mentioned, are built in the same proportion and embody the same requirements in their particular class as the foreign-made automobile engines hold to-day in their class. In other words, the slow-speed American marine engine that has been in use for so many years is not suitable for the light shell of the typical auto boat. American manufacturers are beginning to realize this point, and doubtless we will see great improvements made in the construction and details of the American marine engine used for this class of racing boat. In my opinion, the auto boat is not to be simply a fad, but will fill certain demands that boat builders have as yet been unable to meet. This demand is for a boat to be used on small bodies of water where long-distance cruising is not possible, but where the exhilaration of high-speed racing may be enjoyed.

Steamship Dakota.—On February 7 the *Dakota* was launched from the yard of the Eastern Steamship Company, Groton, Conn. She is a sister ship to the *Minnesota,* launched in April last, and which was fully described in Marine Engineering for May, 1903. The principal dimensions of the *Dakota* are: Length over all, 630 feet, between perpendiculars, 608 feet; beam, molded, 73 feet; draft, 33 feet; displacement, load, 33,000 tons. It is stated that the *Minnesota* will be in condition for her sea trial next July and the *Dakota* in September.

Cruiser Charleston.—On January 22 the protected cruiser *Charleston* was launched at the yards of the Newport News Shipbuilding and Dry Dock Company. The event was very successful and the ceremonies were attended by many state and government officials. The principal dimensions of the ship are as follows: Length on water line, 424 feet; extreme breadth, 66 feet; mean normal draft, 22 feet 6 inches; corresponding displacement, 9,684 tons. The ship will be propelled at an estimated contract speed of 22 knots by two sets of four-cylinder, triple-expansion engines, with cylinders 36, 59.5, 69 and 69 inches diameter by 45 inches stroke. The calculated total maximum horsepower is to be 21,000. Twelve Babcock and Wilcox boilers, which will supply the steam, have a grate surface of 1,400 square feet, and a heating surface of 64,000 square feet. The *Charleston* is one of three sister ships authorized by act of Congress June 7, 1900, the other two being the *Milwaukee,* building at the Union Iron Works, and the *St. Louis* at the yard of Neafie and Levy Ship and Engine Building Company. She will have a main battery of fourteen 6-inch R. F. guns, for it is not intended that ships of this class should engage in the battel line. Her secondary battery consists of eighteen 3-inch R. F., and thirty-eight smaller pieces. She is fitted with a protective deck 3 inches thick on the slopes and 2 inches on the sides, but the only other protection on the water line is afforded by corn pith belt.

OFFICIAL TRIAL AND DESCRIPTION OF THE IMPERIAL OTTOMAN CRUISER MEDJIDIA.

In the year 1900 Ahmed Pasha, chief engineer of the Ottoman navy, came to this country for the purpose of examining our system of naval construction. After surveying the various shipyards, their facilities and methods, and the results in vessels built, he proposed, on behalf of the sultan, to contract with the William Cramp and Sons Ship and Engine Building Company for the production of a twenty-two knot protected cruiser. Plans and specifications were prepared and submitted to the Ottoman Admiralty, which, after thorough examination and a few minor changes to meet special requirements, were approved, and the contract for the construction of such a vessel signed. The contract included hull, engines, armor, guns, and all fittings necessary to make the ship complete and ready for service at sea.

NEW AMERICAN-BUILT IMPERIAL OTTOMAN CRUISER MEDJIDIA, AT ANCHOR IN THE DELAWARE.

[Photograph by J. W. Dawson,]

This vessel is of the protected cruiser type, the engines, boilers, and magazines being placed under an armored deck. The principal hull dimensions are as follows: Length over all, 335 feet 11 inches; beam molded, 42 feet; depth molded to upper deck, 30 feet; draft, normal mean, 16 feet 1 inch; corresponding displacement, 3,432 tons. Other dimensions will be found on page 126.

GENERAL ARRANGEMENT.

In the hold forward of the boiler room are trimming tank, wet provisions, store room, chain locker, magazines, and handling room. Coal is stored in compartments forward of boiler room and at sides. Aft of the engine room are engine stores and fresh-water tank.

On the forward platform deck are wet provisions and magazines. On the aft platform deck are dynamo room, evaporator room, magazines, steering gear, and general stores.

On the protective deck are rooms for lamps, sails, crew space, boatswain's and carpenter's stores, cold storage, coal bunkers, fan room, bread room, ordnance and electrical stores, dry provisions, armory, paymaster's, warrant officers', junior officers', ward room, and captain's stores.

On the berth deck are captain's and officers' quarters, ward room, the junior and warrant officers' quarters, pantries, bath rooms, water closets, etc., crew spaces, wash rooms and water closets, crew sick bay, dispensary, drying room, ice machine, work shop, windlass engine, and torpedo tubes.

On the upper deck are the armament and galleys.

ARMAMENT.

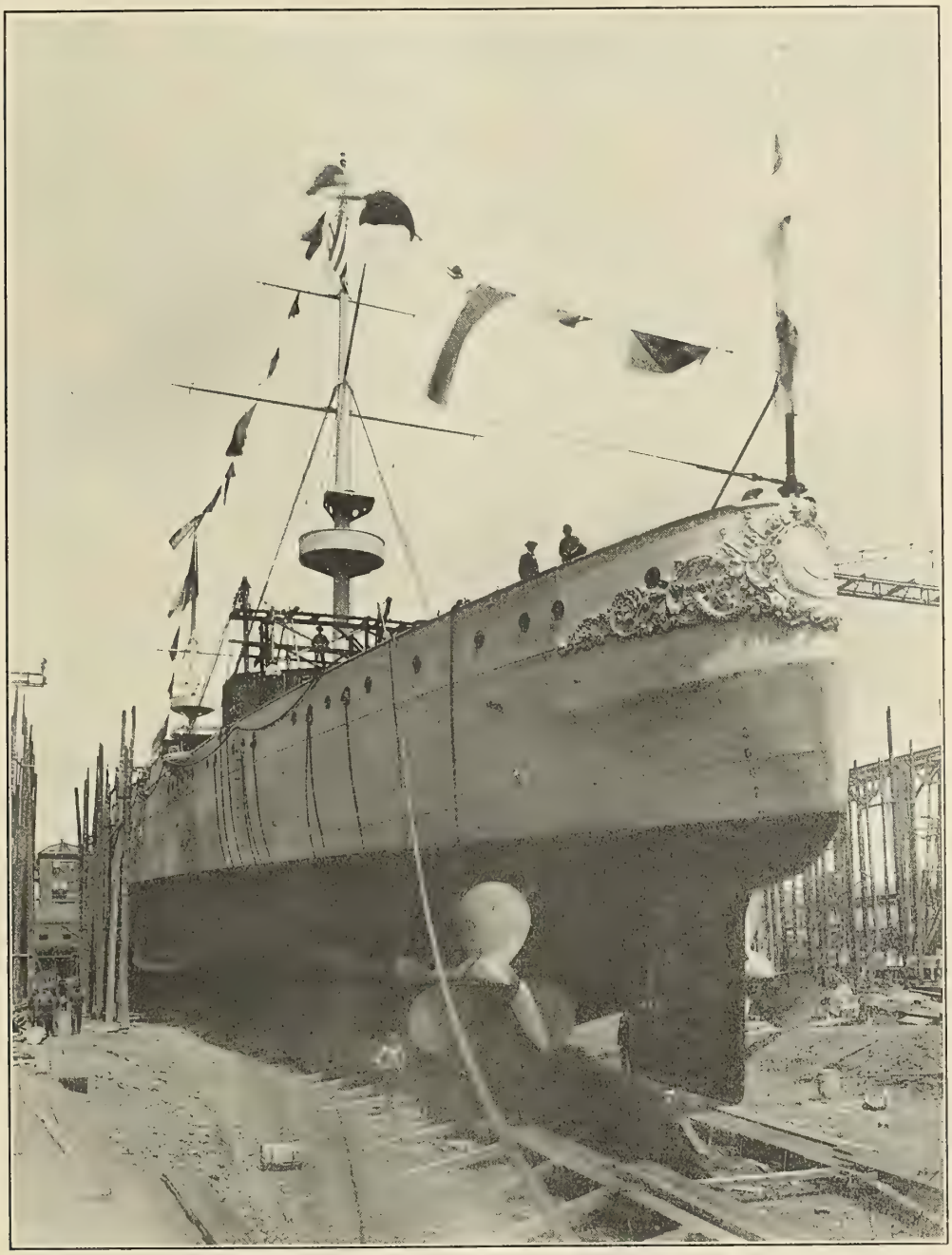
There is a protective deck extending fore and aft, the central portion rising above the load line and sloping at the sides to 4 feet below the load line. The maximum thickness of armor on the slopes is 4 inches. The ship is otherwise unarmored except that the conning position is armored with 4-inch plates.

The battery consists of the following guns: two 6-inch, 45 calibre; eight 4.7, 50 calibre, rapid firing; six 3-pounders; six 1-pounders, semi-automatic, 50 calibre, rapid firing; one 3-inch field gun; and two broadside 14 inches above-water Whitehead torpedo tubes.

As will be noted, the battery is entirely of rapid-firing guns, and for the displacement of the vessel is very powerful. The forward and after pair of 4.7-inch guns fire directly ahead and astern respectively and have each

a total arc of fire of 150 degrees. The balance of the 4.7-inch guns have a broadside train of 120 degrees each. The 3- and 1-pounders are so mounted on the bridges, hammock berthings, and military masts as to give the

the hoops ordinarily terminate, and are in accordance with the most modern United States guns. The guns were built by the Bethlehem Steel Company and are entirely the product of American manufacture; in fact,



OTTOMAN CRUISER MEDJIDIA, JUST BEFORE LAUNCHING, IN THE YARD OF THE WILLIAM CRAMP AND SONS' SHIP AND ENGINE BUILDING COMPANY.

best train and protection to the ship against torpedo-boat attack.

The guns are so arranged as to have one 6-inch and two 4.7-inch ahead, and the same astern. The broadside fire consists of two 6-inch and four 4.7-inch guns. All the guns are of the latest type and the 6-inch and 4.7-inch are hooped to the muzzle, thus providing against any sudden diminution of the strength of the guns where

the whole vessel throughout, in material, outfit, and construction is of American production and workmanship.

The battery is supplied with ammunition by eight electrical hoists of the endless-chain type.

DRAINAGE SYSTEM.

The main drainage system consists of two 7-inch

pipes extending from forward boiler room to the engine room, where they are connected to the main condenser circulating pump.

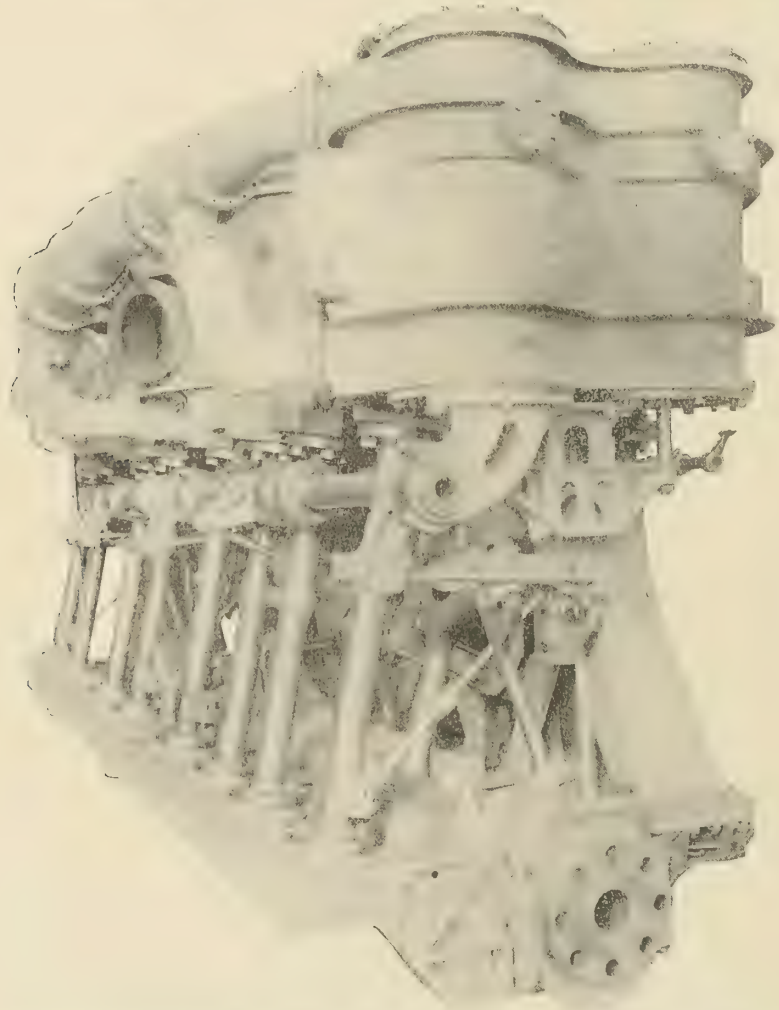
There is a secondary drainage system with 5-inch connections to the machinery space and the compartments forward and abaft of them. Each compartment of the double bottom has an independent suction.

The water above the protective deck is emptied by portable hand pumps, with flexible hose, or by scuppers.

in each engine room. The reversing engine is of the steam-floating lever pattern. The turning engine is a double-inverted engine working through worm gearing.

The principal dimensions of engines will be found in the table.

There are two main condensers. The shells are oval in shape, made of composition. Each condenser has 3,078 tubes 5-8 inch outside diameter and No. 17 B. W. G., giving a cooling surface of 7,110 square feet each.



4-CYLINDER, TRIPLE-EXPANSION ENGINE FOR THE IMPERIAL OTTOMAN CRUISER MEDJIDIA.

MACHINERY.

The propelling engines are right and left, placed in separate water-tight compartments abreast of each other. They are of the vertical four-cylinder, direct-acting, triple-expansion type, with high-pressure cylinders forward and the two low-pressures aft. The main valves are of the piston type with Stephenson link motion. There is one double-ported valve for the high-pressure cylinder and two single-ported valves for the intermediate- and each low-pressure cylinder.

The framing consists of a cast-steel housing at the back and forged-steel columns at the front. The pistons are of cast steel and conical in shape. All cylinders are fitted with working liners. The intermediate- and low-pressure cylinders are jacketed. The bed plates are of cast steel of "I" section. A steam separator is fitted

There are two main centrifugal circulating pumps with 14-inch inlet and outlet. Each pump has an engine 6 inches diameter by 6 inches stroke.

There are also the following steam pumps:

2	Air pumps.	10 by 23½ by 15 ins.
2	Main feed pumps,	12 by 7 by 12 ins.
2	Auxiliary feed pumps,	12 by 7 by 12 ins.
2	Hot well pumps,	7½ by 8½ by 10 ins.
2	Water service pumps,	5½ by 4¾ by 5 ins.
2	Crank pit pumps,	5¼ by 4¾ by 5 ins.
2	Fire and bilge pumps,	9 by 5¼ by 10 ins.

Besides these pumps there are the oil pumps, etc.

In the port engine room there is one Wheeler auxiliary condenser with 500 square feet cooling surface and combined air and circulating pump 7 1-2 by 9 by 9 by 10 inches.

In the passage between the after fire rooms is one feed-water heater made of steel shell plates and composition heads containing 806 square feet of heating surface. There are two feed tanks each of 1,000 gallons capacity, fitted with sponges for filtering.

The propellers are made of Parsons manganese bronze; the starboard propeller is right hand and the port left hand. The propellers are of the built-up type, each having three blades.

There are sixteen Niclausse water-tube boilers, designed for a working steam pressure of 275 pounds. The boilers are arranged in three groups in four fire rooms, two single and two double. There are 238 elements in all. Each element has four evaporating tubes 3 1-4 inches outside diameter and twenty-nine tubes 1 9-16 inches outside diameter. All are seamless drawn tubes. Boilers are fitted with automatic feed valves and automatically closing fire doors and balanced ash-pit doors. The total grate surface is 775 square feet and the total heating surface is 28,857 square feet. There are three smoke pipes with a combined area of 151.42 square feet.

Forced draft on the closed stoke-hold system is provided by eight blowers 5 feet diameter, the four forward fans being 14 inches and the after four are 18 inches wide at the tip. As space in the fire room was limited a new departure was made in the arrangement of these blowers, which proved entirely successful. The blowers were located in rooms over the protective deck, two in each room. The rooms communicate with the living quarters and with the open air through hatches, the blowers drawing air through these sources and delivering it through openings in the deck to the stoke hold below.

Fresh air for ventilation is supplied under pressure by eleven electrically-driven fans, while the exhaust is by natural means.

There are two evaporators with a capacity of 7,500 gallons of feed water every twenty-four hours, and one distiller with a capacity of 7,000 gallons of drinking water per twenty-four hours. The plant is fitted with the necessary pumps, filters, etc.

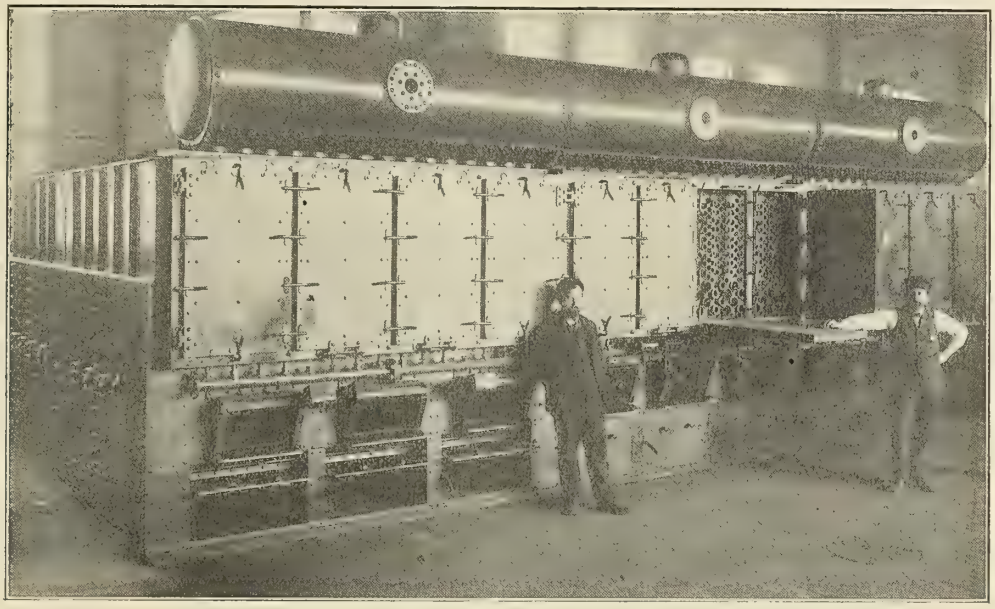
The refrigerating equipment consists of one Allen dense-air ice machine capable of producing one ton of ice per twenty-four hours. A workshop is provided which is fitted with an emery grinder, shaper, drill press, and a screw-cutting lathe, all driven by an electric motor.

There are two 50-Kw. dynamos fitted with all the necessary details, including four 24-inch search lights.

The vessel is also fitted with telegraphs, ash hoists, steering engine, windlass, boats, etc.

OFFICIAL TRIAL.

The official trials of the *Medjidia* were held on the Chesapeake bay, the standardizing runs being over the Barren island course. The first three double standardizing runs were made on December 17, 1903, and the last two on the 19th of December, 1903. Each standardizing run consisted of one run up and back over the measured mile. On each run, time, revolutions, indicator cards, etc., were taken. These conditions and results will be found on page 126. From the data obtained on these runs a speed curve was constructed, from which was determined the speed made during the six-hour endurance trial, which followed immediately after the last standardizing run. On this trial the revolution counter readings were taken every fifteen minutes, the other engine and boiler conditions every half hour. A summary of these results will be found in the data card on the next page.



NICLAUSSE BOILERS ON THE MEDJIDIA, ERECTED IN THE SHOP.

The mean draft for the trial was 16 feet 6 inches, with a displacement of 3,540 tons.

It will be noted that during the speed trials of December 19 the *Medjidia* maintained an average speed of 22.29 knots per hour over the measured mile, thus exceeding her contract speed by .29 of a knot. The run home from the trial course was made in moderately bad weather, when the vessel proved herself to be a most staunch and easy sea boat.

During the preparation of the working plans and de-

Standardizing Trial of the Imperial Ottoman Cruiser Medjidia.

Barren Island Course. December 17-19, 1903.

	First Double Run.		Second Double Run.		Third Double Run.		Fourth Double Run.		Fifth Double Run.	
	1st Leg.	2d Leg.	1st Leg.	2d Leg.	1st Leg.	2d Leg.	1st Leg.	2d Leg.	1st Leg.	2d Leg.
Duration of run, minutes and seconds	4-37	5-25	3-51	4-17	3-22	3-29	2-51	2-46	2-42	2-41
Speed, knots	12 996	11.07	15.584	14.008	17.822	17.225	21.05	21.69	22.22	21.36
Mean speed during double run.	12.136 knots.		14.796 knots.		17.523 knots.		21.37 knots.		22.29 knots.	
Mean indicated horsepower	1420		2706		4716		9071		10347	
Mean revolutions for double run, per minute	101.1		124.23		151.05		183 93		191.05	
Apparent slip of propeller, per cent	9.9		9.9		12.1		12.1		11.8	
Steam pressure, at engines	257	244	230	225	228	269	248	235	237	240

Marine Engineering Data Card. **March, 1904.**

Name—Medjidia. Nationality—Turkish. Type—Protected Cruiser.
Launched—1903. Builder—Cramp's Shipyard. Owner—Turkey.

Length over all.....335 ft. 11 in.
" between perpendiculars.....330 " 0 "
Beam, molded.....42 " 0 "
Depth, molded to upper deck.....30 " 0 "
Normal displacement.....3,432 tons
Full load " .....3,757 "
Mean normal draft.....16 ft. 1 in.
Tons per inch of displacement.....22.3
Ratio, length to beam.....7.85
Block coef.....535
Midship section coef.....925
Load water line " 675
Number of frames.....82
Distance between frames.....4 ft.
Number of watertight compartments.....108
Engines.....twin-screw, four-cyl., triple
Cylinder diam....30, 47, 52, and 52 in.
Stroke.....30 "
Piston rods, diam., H.P. & M P., 6 1-4 in.; L.P., 5 1-4 in.
Connecting rods, upper end, diam., H.P. & M.P., 5 1-2 in.; L.P., 4 1-2 in.
Connecting rods, lower end, diam., H.P. & M P., 6 1-2 in.; L.P., 5 1-2 in.
Connecting rod, length, center to center....5 ft.
Crank shaft, diam..13 3-4 in. outside, 7 in. inside
" pins, " ..14 1-2 " " 7 " "
Thrust shaft, " .....13 3 4 in.
" collars, cast shaft, number.....13
Line shafting, diam.....13 in.
Stern tube and propeller shaft, diam....13 3-4 "
Main steam pipe, diam.....11 1 2 "
Cooling surface, two condensers.....14,220 sq. ft.
Propellers, material .....Manganese bronze
Boilers, type.....Niclausse water-tube
Number.....16
Elements, number.....238
Grate surface, total.....775 sq. ft.
Heating " " .....28,857 " "
Working pressure.....225 lbs.

Trial Data **Marine Engineering Data Card.** **March, 1904.**

Name—Medjidia. Nationality—Turkish. Type—Protected cruiser.
Launched—1903. Builder—Cramps' Shipyard. Owner—Turkey.

Time: Length of trial .....6 hours
Steam Pressure: Boilers.....224.5 pounds
Engine, port, 228; starb.....225 "
H. P. receiver, port, 179; starb....173 "
M. P. " " 63; " .... 62 "
L. P. " " 13; " .... 9.8 "
Vacuum, port, 26; starb.....26 ins.
R. P. M. from counter, port, 179.6; starb 176.2
Double stroke air pump, " 29; " 26
Rev. circulating " " 231; " 205
Temperature: Injectors, port, 39°; starb. 39.7° F.
Discharge, port, 107°; starb.....109° F.
Feed.....102° F.
Air Pressure, forward fire room.....1-2 in.
Forward middle " " .....1-4 "
Aft " " " ...1-2 in.
" fire room .....3-8 "
Speed of ship in knots from curve.....20.65
Slip from curve.....12.3

Horsepower, port, H. P..... 1,500
" " M. P.....1,472
" " F. L. P..... 810
" " A. L. P..... 796
Total.....4,5-8
Horsepower, starb., H. P.....1,513
" " M. P.....1,514
" " F. L. P..... 758
" " A. L. P.. 696
Total..... 4,471
I. H. P., both main engines.....9,049
Draft, mean. ..... 16 ft. 6 ins.
Displacement, tons.....3 540
H. S. in use..... 28,857.5 sq ft.
G. S. " " ..... 775 " "
I. H. P. ÷ G. S.....11 6
H. S. ÷ I. H. P..... 3.18
Admiralty coef 226

signs, also the construction of the vessel, machinery, and arrangement, the sultan has been represented by Lieutenant-Commander Sabri Bey, of the engineer corps, and Lieutenant Ali Bey, of the construction corps. Both of these gentlemen have been highly educated in all that pertains to the building of war vessels and their machinery. They have been most faithful in the performance of their duties and have maintained the respect and admiration of all with whom they have come in contact.

Doubtless this vessel, the product of American workmanship, with her remarkably graceful appearance, will prove a most valuable addition to the Ottoman Navy when she is delivered to the authorities at Constantinople.

RACING MOTOR BOAT STANDARD, RUNNING AT FULL SPEED IN NEW YORK BAY.

Racing Motor Boat Standard.

During the spring of 1903 the United States Long Distance Automobile Company desired competitive bids on a 60-foot hull for a high-speed launch in which to install one of its new 110-horsepower gasoline motors and test its capabilities. A number of designers were asked to submit plans for the proposed boat, which was to fulfill the following requirements:

1. That the hull should be of extreme lightness without sacrificing the strength consistent with the estimated power of the engine.

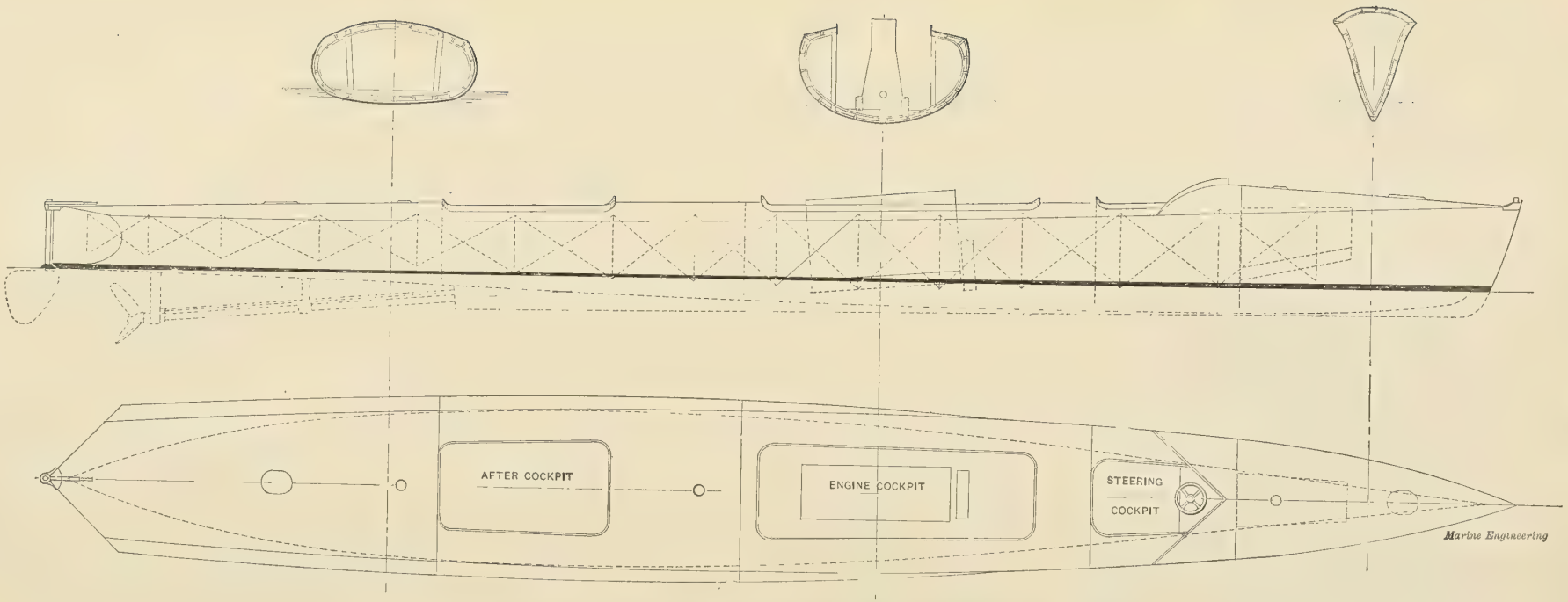
2. That the hull should be made of such form as to obtain the greatest possible speed on the given length, and be perfectly able and seaworthy in the ordinary run of weather about New York harbor, lower bay, and sound.

After consideration of all the plans submitted, the contract was awarded to the Marine Construction and Dry Dock Company, who designed and built the boat at its works, Mariner's Harbor, Staten island. The dimensions of the launch are: Length over all, 60 feet; length on load water line, 58 feet; extreme beam, 7 feet 6 inches.

A departure was made from the usual method of construction, and the novel and scientific scheme adopted, for which a patent has been applied, afforded great saving of weight in every detail. The planking is of single-thickness, Honduras mahogany, finished to 3-16 inch. The fore and aft plank edges are also on continuous longitudinals of Oregon pine and fastened to them with brass screws closely spaced and let in flange. As shown in the sketch, a system of double framing is used. The longitudinals are notched for the outer frame, and the inner frame, longitudinal, and outer frame are through riveted, making a very light but substantial arrangement. The inner frame is in one length and forms the lower member of the deck beam, the outer member running from side to side only. The longitudinal strength of the boat is obtained from two truss girders running from end to end in the wings and consisting of upper and lower continuous longitudinals, wooden compression struts, and galvanized wire diagonals set up very tight. These girders were designed to take off any hogging or sagging strains which might occur under the most extreme conditions. Care was taken to have the weight of the engine well distributed fore and aft, and this was effected by means of deep floors under the engine bearings, these floors resting on the longitudinals and lower members to the girders.

Special mention should be made of the engine which has many novel features. The system of forged columns and diagonal bracing gives a general appearance of similarity to a marine engine; it is of the four-cycle type with six cylinders, each 8 inches diameter and 10 inches stroke. The most interesting feature is the ingenious method of manipulating the engine by means of compressed air, and thus doing away with the usual reversing clutch. A pump is attached to the after end of the shaft and compresses air into a reservoir to the pressure of 150 pounds. In addition to the regular set of inlet and exhaust valves fitted on each cylinder for controlling the gas, on two of the cylinders a second set of valves is employed for the compressed air. Each set of valves is operated by a cam shaft, and each shaft has two sets of cams, one for going ahead and the other for reversing. The operations of starting, stopping, and reversing are controlled by means of horizontal levers worked in a notched quadrant similar to steam-engine brackets.

The *Standard* developed great speed on its numerous trials, and was successfully raced during the summer against many of the fastest yachts and steamers in the vicinity of New York. The most remarkable of its performances was the easy defeat of the steamer *Monmouth* in an informal race from Atlantic Highlands to the Battery, most of the trip being accomplished in a moderate seaway, which did not seem in any way to affect the speed of the launch. In this and other trials in rough and broken water the boat proved dry and



PLAN AND SECTIONS SHOWING THE CONSTRUCTION OF THE RACING MOTOR BOAT STANDARD.

seaworthy, with easy motions, no vibrations, twisting or evidences of any straining. The highest speed developed by the *Standard* was about 23 miles, but this was with the experimental propellers, which did not give satisfactory results. It is expected that with a suitable wheel the speed will be considerably better next season.

Liquid Fuel.—The American-Hawaiian Company's steamship *Nebraskan* left San Francisco on January 20 for New York direct with a supply of fuel oil in her bunkers for use under the boilers for the entire trip. This is the first steamer to make that voyage of 13,000 miles using oil alone for fuel. The capacity of the oil tanks was 10,000 barrels.

Scout Ships Fitted With Turbines.—The Navy department has submitted a proposition to the Westinghouse, General Electric, and Allis-Chalmers companies for a complete installation of steam turbines for 3,700-ton scout ships, included in this year's naval program. The latter company has just entered the turbine field, and is prepared to undertake the installation of turbines for marine propulsion and electric generation. The first plans of the Navy were for scout ships of 1,200 tons, but upon learning that vessels of this class are being built for the German Navy, to be propelled by turbines and to be of very much greater speed, the department changed its plans and increased the size of the scouts to 3,700 tons each. It is stated that a speed of 26 knots is considered, which will require the installation to be of at least 20,000 horsepower. In figuring up the space to be occupied by the turbines, it was found that while the motors themselves occupy less room than reciprocating engines, owing to the high vacuum necessary to maintain, the auxiliaries must be considerably larger.

Extension of Navigation Laws.—It is to be hoped that at the present session Congress will pass the Frye bill for the extension of the navigation laws to the Philippines, whereby none but ships of American registry can partake in the coast commerce of the islands or in the commerce between the United States and those islands. Small opposition has been encountered from certain cordage manufacturers, but the bulk of testimony given before the Senate Committee on the Philippines was in favor of the passage of this bill.

NEW AUSTRALIAN LINER NIKKO-MARU.

The *Nikko-Maru,* which was launched from the Tategami shipyard of Mitsu Bishi Dockyard and Engine Works on October 23, 1903, is a steel single-screw steamer of 5,600 tons gross, built especially for the Nippon Yusen Kaisha's Australian service. The dimensions are 420 feet long between perpendiculars, 50 feet beam, 30 1-2 feet depth. The ship is very elaborately fitted for the accommodation of 60 first-class passengers, 28 second class, 24 intermediate, and 108 steerage passengers. She has a straight stem, an elliptical stern, a poop, bridge, and forecastle, one funnel, and two pole masts. She is divided into eight water-tight compartments and is constructed with double bottom right, forward, and aft. There are two complete decks, upper and main. The bridge deck, which extends for a length of 175 feet, is sheltered by the shade deck and reserved for the first-class passenger's promenade, while the poop is for the second class. At the forward end of the shade deck are the captain's and other officers' cabins, Chadburn's steering, docking, and engine-room telegraphs, Lord Kelvin's compass, and other modern nautical appliances. The navigating bridge is over the chart room.

The first saloon, social hall, and smoking room in the ship are on the bridge deck. The chief decorative feature of the saloon is a square-trunk skylight which rises 21 feet from the saloon floor to the height of navigating bridge, and is 10 feet square. The upper part of the skylight is of rich stained glass. In the forward end of the saloon there are two large wireless cloisonne panels worked in wall; one panel representing wild ducks in water and the other wild ducks in flight. These are by Mr. Namikawa, a member of the Imperial household artisans and famous for his wireless cloisonne ware. The saloon itself is panelled in white oak with moderate carvings and is well lighted from the side by Messrs. J. Stone and Company's new patent large rectangular sliding windows. The revolving chairs with eccentric motion have stuffed and cane seats, so that they may be reversed to suit the climate. The sofa seats along both sides of the saloon are stuffed and covered with olive-green morocco leather, and the floor is covered with rich axminster carpet. Furniture, such as tables and sideboards, are all of white oak; these with the general finish of the saloon are of inter-Anglo-Japanese nouveau design.

The saloon is large enough to seat 80 persons to table at one time and as a whole forms a very luxurious and comfortable saloon. Aft of the saloon is the grand stairway, panelled also in white oak and similar finish to the saloon, giving access to the first-class cabins on the upper deck. It is lighted overhead by a large skylight glazed with stained glass, as well as from the sides. The center panel is a large art silk velvet, with a magnificent picture of a water fall in black and white, prepared by Mr. Iida of Kyoto.

Situated abaft the grand stairway is the saloon pantry, well equipped with steam table, sinks, water boiler, filter, etc., all complete. The floors of saloon entrance and saloon pantry are covered with india-rubber mats. The social hall is at the forward end of the saloon; the wall is lined with white oak and finished similarly to the saloon. There are three silk panels with classic pictures of Mount Arashi (a mountain near Kyoto famous for its cherry blossoms), woven in silk goblin fabric. The social hall is furnished with piano, writing desks, and a number of easy and occasional chairs. It will not be amiss to add here that this social hall was fitted up at the Osaka exhibition this year and was used by their Imperial Majesties the Emperor and Empress as a retiring room during their visit. The furniture is in peacock blue with classic bamboo and flora-paullonia design in silk damask. All these fabrics are by Mr. Kawashima, a well-known silk weaver and a member of Imperial houshold artisans, to the builder's design. The floor is covered with rich axminster carpet.

Further aft on the bridge deck is the first-class smoking room, with walls carried up above the level of the shade deck, thus giving a greater head room. Light is admitted through large stained-glass skylight on top as well as by large rectangular windows at the sides. The walls are panelled in stained oak and adorned with an embroidery work of three "Do Not" monkeys from the painting specially executed by Mr. Takeda Seiho, a well-known Kyoto artist. The furniture includes comfortable settees, revolving chairs, and whist tables. Settees and chairs are covered with olive-green morocco leather. The floor is covered with india-rubber tiles made and supplied by Gorham Rubber Company, U. S. A. This room has a bar fitted with all modern requisites.

The accommodations for the first-class passengers, engineers, surgeon, purser, and other officers, and surgery, barber shop, galleys, etc., are in the bridge on the upper deck. There are twenty-eight first-class state rooms on the upper deck and two on the bridge deck; each room is fitted up for two passengers and is provided with iron folding beds, Broadfoot's fold-up lavatory, electric bells, and all those little accessories and conveniences which add so much to the comfort of passengers.

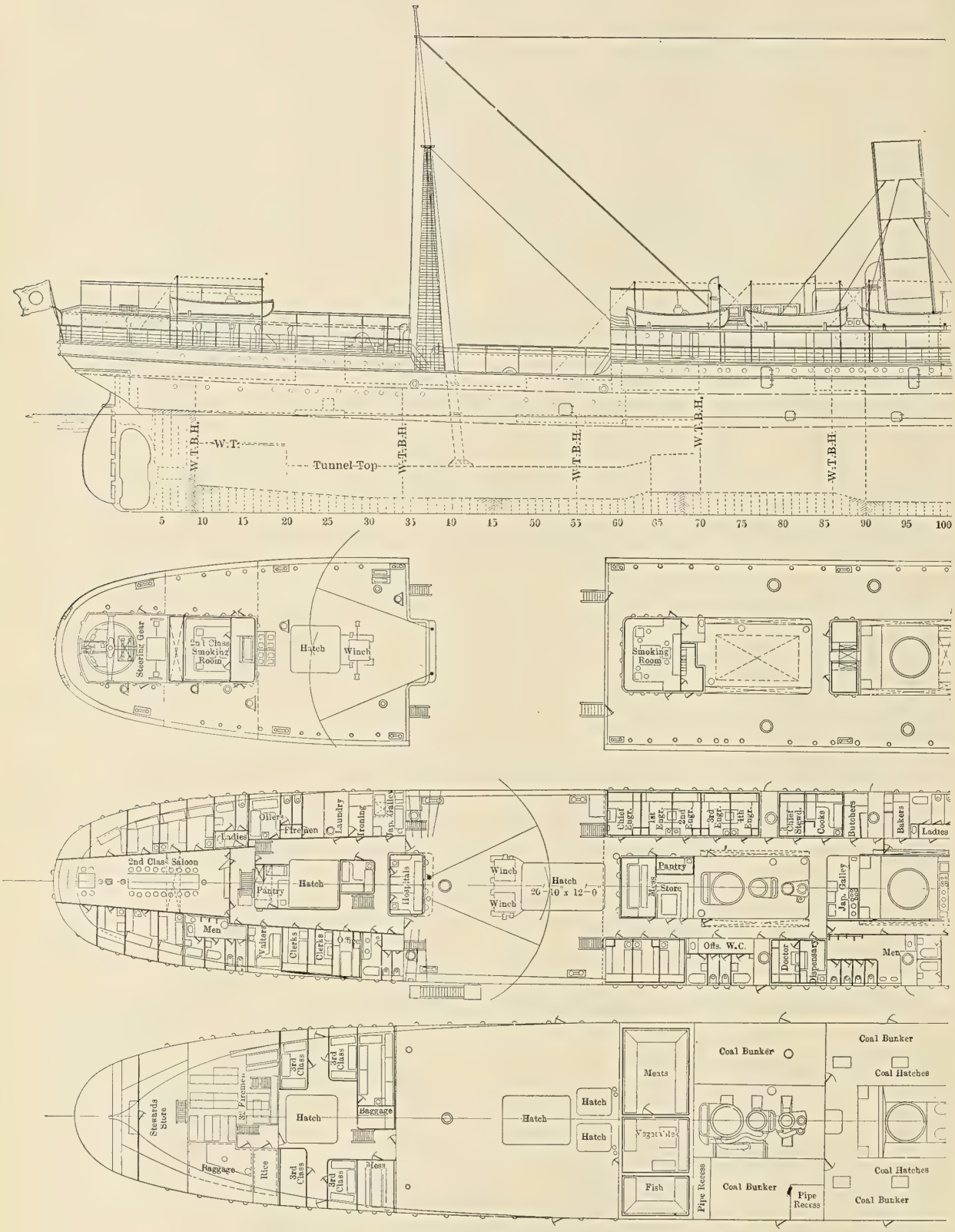
A poop 95 feet long forms the promenade. Upon it is built a steel house containing the steering engine, an entrance hall to the saloon below, and the smoking room which is furnished with piano, sofa seats, chairs, and tables. The floor is covered with india-rubber mats.

The furniture in the dining saloon includes a handsome sideboard, large dining table, small family table, and twenty-five revolving chairs. Both the saloon and smoking room are panelled in stained oak and of inter-Anglo-Japanese nouveau design. Seats and chairs are covered with mock-morone morocco leather, and the floor is laid with brussels carpet. Along each side of the saloon there are state rooms, provided with iron folding beds, fold-up lavatory, etc., all finished in general respect equal to the first-class state rooms of an ordinary transpacific passenger steamer.

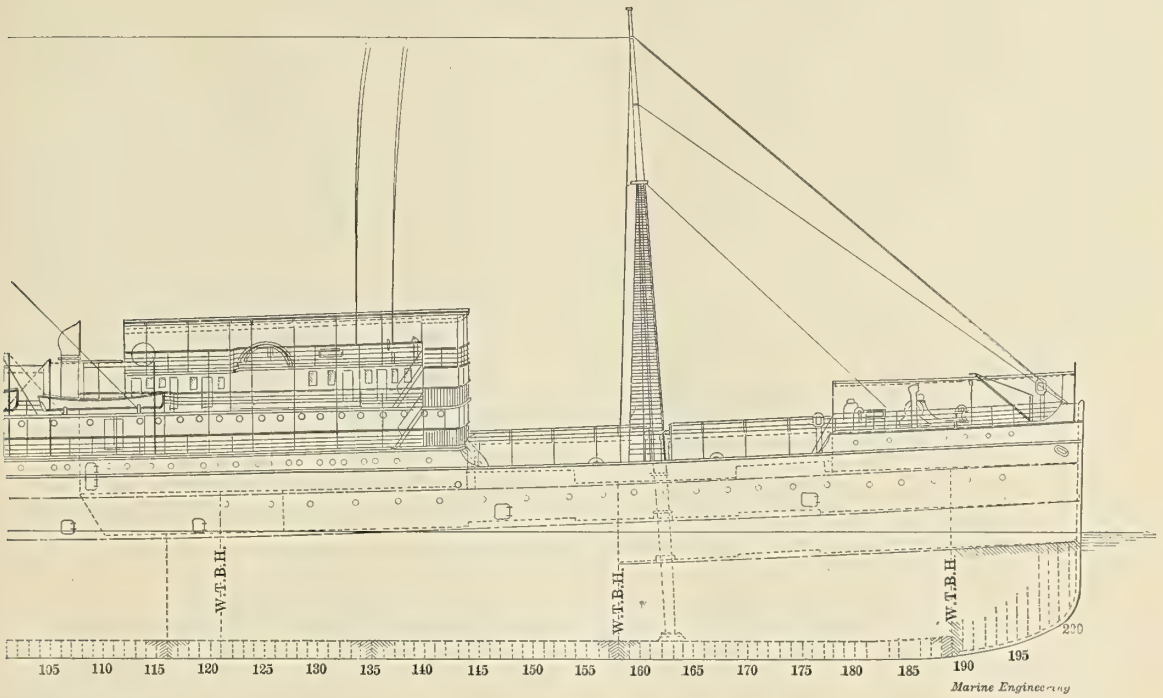
The after part of the main deck is given up to intermediate passengers and fore part to steerage passengers. Hoskin's patent portable iron beds are fitted in these quarters. The sanitary arrangements are very complete, the baths are of enamelled fire clay placed in large airy rooms with salt and fresh-water supply, douche, etc.

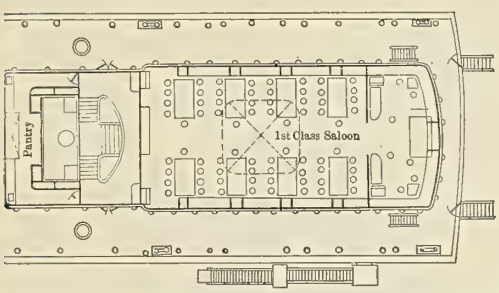
The vessel is provided with a sufficient number of boats to carry everybody on board when she has her full complement; and all boats are fitted with Mills' patent disengaging gear.

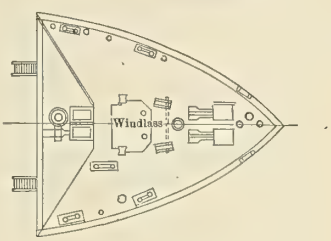
The deck machinery consists of six powerful steam

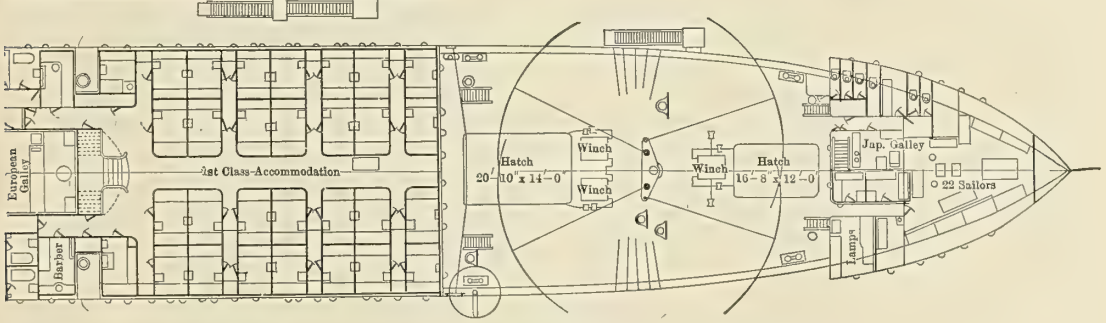


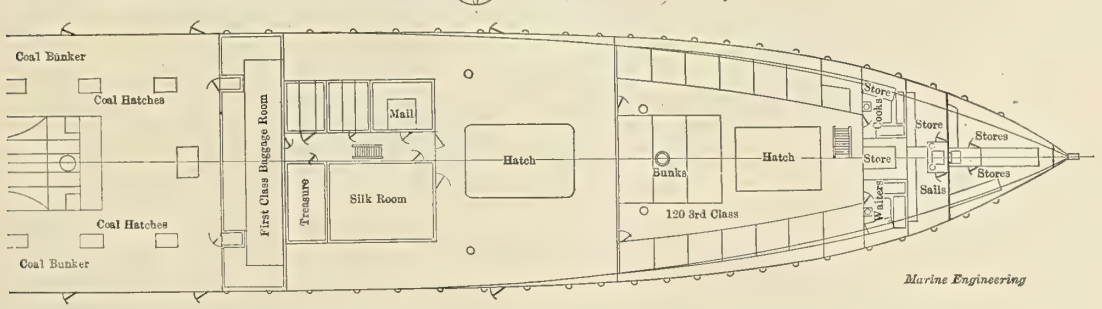
INBOARD, PROFILE, AND DECK PLANS OF THE NEW PACIFIC LINER NIKKO-MARU











FOR THE AUSTRALIAN SERVICE OF THE NIPPON YUSEN KAISHA.

winches, steam steering gear, made by Messrs. Caldwell and Company, with Hastie's patent spring brake on steering circle, hand-screw steering gear, and Napier's patent vertical steam windlasses, etc.

The *Nikko* is lighted throughout by electricity and affords a striking instance of the extent and completeness of the installations which are now fitted in first-class passenger steamers. The total number of lamps is over 500, making the total candle power slightly above 10,000, and to this must be added ten cargo lamps each of 250 candle power. The installation is on the double-wire system and the current is supplied at a tension of 100 volts by one compound engine, driving direct-compound wound dynamo having drum-wound armature, of Clark, Chapman and Company's make and provided with dynamo in duplicate. From an artistic point of view the installation must be pronounced extremely pleasing to the eye. In saloons, social hall, smoking rooms and state rooms the fittings are mostly silver plate, well harmonizing with the general design and coloring. The engine and boiler rooms and quarters for the sailors, etc., are amply lighted. The installation includes the signal lamps at the mast heads, sides, and stern of the vessel, and in addition a large number of electric fans for the ventilation of the passenger accommodations and holds. A special feature of the vessel is the heating and cooling arrangement by Stewart's thermo-tank system. The plant consists of four large electric fans arranged to draw the fresh air through a ventilator and to discharge it through a nest of steam pipes with ample heating surface. The warmed air is carried all forward and aft of the different apartments by means of galvanized sheet-iron trunks with openings, so that the warm air may be obtained in any room and apartment. The same apparatus is so arranged as may be used for cooling the air by leading a current of brine through the coil in thermo-tanks. The *Nikko* is the second vessel flying the Japanese flag fitted with this plant, the first being *Kumano-Maru,* also in the Australian service.

The vessel is fitted with a large Hall refrigerating plant capable of making 1,500 pounds of ice per day or of cooling spacious refrigerating chamber. Cooking ranges, grills, electric ironing apparatus, hot press, vegetable steamer, etc., all of the latest type, further add to her complete equipment as a modern passenger steamer.

The engines of the vessel consist of one set of triple-expansion engines having cylinders of 31, 51, and 85 inches in diameter by 54 inches stroke. Steam exhausts into a separate cylindrical condenser with 6,414 square feet of cooling surface with a centrifugal circulating pump driven by independent engines. An Edwards' air pump, two feed, and two bilge pumps are driven by main engines. The valve gear is of the ordinary double-bar link motion type and like the whole of the working parts is provided with very large wearing surfaces. Special care has been taken to render every part as accessible as possible and the adjustments easy of execution. There are two single-ended boilers each of 15 feet 6 inches diameter by 10 feet 6 inches long, and two double-ended boilers each of 15 feet 6 inches diameter by 18 feet long, containing a total of 14,840 square feet of heating surface. The furnaces, Morrison's patent, are 3 feet 10 inches in diameter, and the grate surface is 465 square feet. See's ash ejectors are fitted in each stoke hold with a powerful pump. Weir feed pumps and heater, and a Morrison evaporator are very conveniently placed. Besides these pumps and those worked by the main engines there are the usual ballast, auxiliary feed, salt, and fresh-water pumps, all conveniently arranged.

The *Nikko,* on her trial, which will take place very shortly, is expected to attain a speed of 17 knots, and on her completion, which will be sometime toward the end of the year, the builders have good reason to believe that this ship will be the finest and best of all the Japanese-Australian liners.

Nippon Yusen Kaisha, or the Japan Mail Steamship Company, Limited, has a fleet which now consists of 77 steamers of a gross tonnage of 242,163 tons and 17,128 nominal horsepower. Besides these there are three vessels now building including the *Nikko-Maru* above described. These vessels were until recently run under government subsidy, and now, since the war has been declared, are operated by the government for transports, etc. In the year just closed, the growth of the freight and passenger business handled by this company has increased very decidedly on all lines except the line

MARINE ENGINEERING DATA CARD. MARCH, 1904.

NAME—Nikko Maru. NATIONALITY—Japanese. TYPE—Ocean steamer.

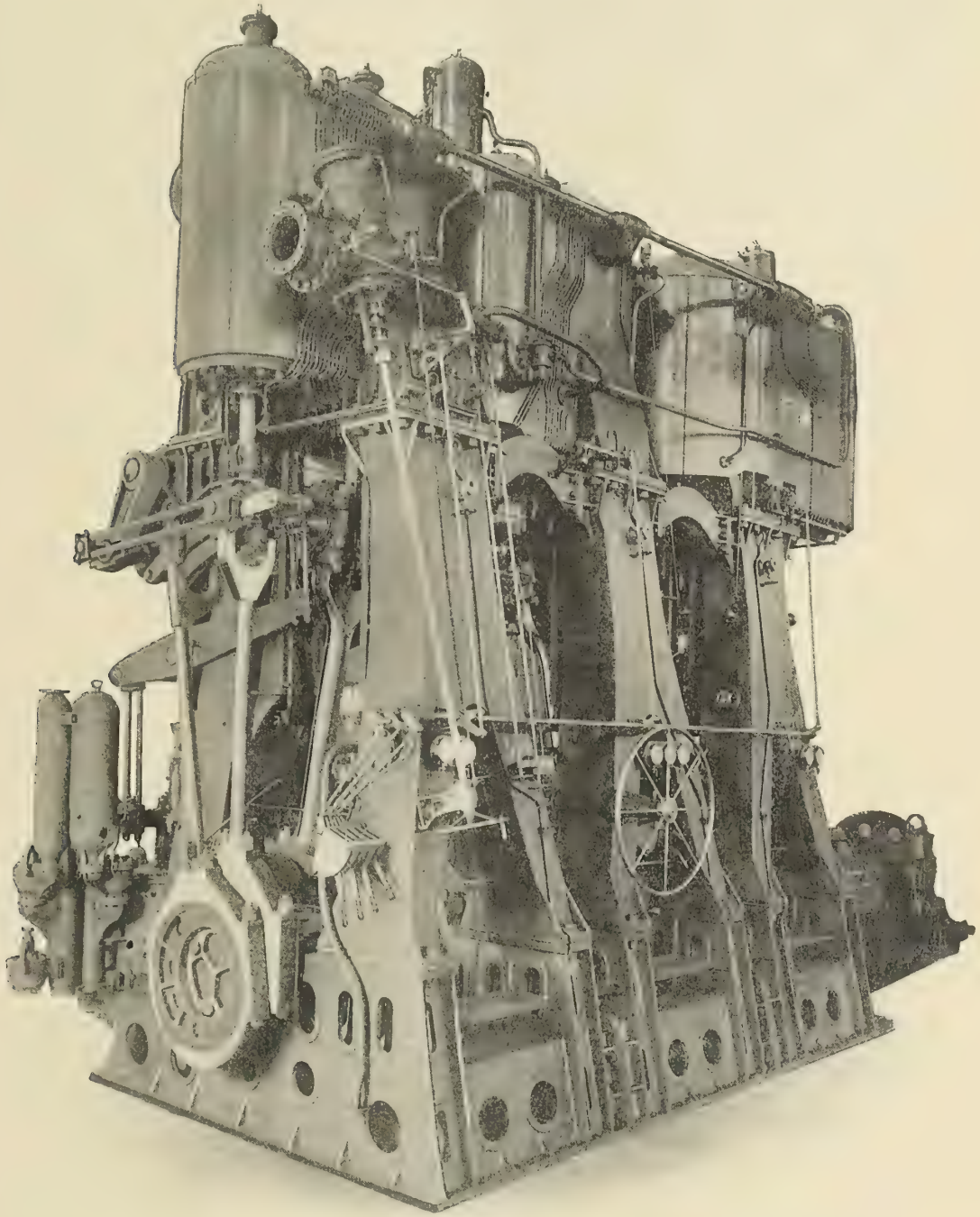
LAUNCHED—1903. BUILDER—Mitsu Bishi D. and E. Works. OWNER—Nippon Yusen Kaisha.

Length over all	434 ft. 0 ins.
" between perps	420 " 0 "
Breadth, molded	50 " 0 "
Depth, "	30 " 6 "
Height between decks	7 " 11 "
Gross tonnage	5,600 tons
Engines:	single, triple
Diameter cylinders	31, 51, and 85 ins.
Stroke	54 ins.
Valves, Piston on H. P., slide on I. P. and L. P.	

Boilers: Number	2 single-end; 2 double-end
Pressure	185 pounds
Diameter	15 ft. 6 ins.
Length	10 ft. 6 ins.; 18 " 0 "
Number of furnaces	18
H. S. total	14,840 sq. ft.
G. S. "	465 " "
I. H. P. on trial, estimated	6,500
Speed on " "	17 knots
H. S. ÷ I. H. P.	2.28
I. H. P ÷ G. S.	13.98
H. S. ÷ G. S.	31.91

running to Vladivostock. It operates lines from Japan to Chinese and Korean ports, to England, Australia, and America, as well as in the coast service among the islands of Japan.

upon a permanent war footing. The changes suggested are: First, alteration in the organization of Navy yards, to result in increasing the power and responsibility. Second, the consolidation of the operators in



TRIPLE-EXPANSION ENGINE OF THE NIKKO-MARU, BUILT BY THE MITSU BISHI DOCKYARD AND ENGINE WORKS, NAGASAKI, JAPAN.

Secretary Moody's Report.—The chief point of interest in the annual report of Mr. Moody, Secretary of the Navy, is a strong recommendation that the entire organization of the Navy be considered by Congress, and that such changes be made that the Navy shall be kept

the department. Third, the creation of a general staff which shall be responsible for the efficiency of the vessels afloat and the personnel of the Navy, to act as military adviser of the Secretary, and to collect and digest military information.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

IN our issue for February we made in these columns some remarks regarding the value of technical education for the engineer, and the qualities which such a course of instruction might be expected to enhance. The further question still remains as to the efficiency with which the technical colleges are doing the work which may be thus expected of them.

The engineer, it should be remembered, stands as the mediator between the energies of nature and the needs of modern civilization. His primary function is to transform such energies from the non-available form, and to use them in the fulfilment of the manifold demands of the industrial world. It follows that the education of the engineer must necessarily have a twofold aspect; that which relates first to the fundamental transformations of energy, and second to its use in detail for the needs of modern industry. The former must be fundamentally scientific; the latter operative, economic, industrial and practical.

If any general criticism can be made on the tendencies of engineering education during the past 20 years, or during the period of its present existence, it may be said that the practical and economic aspects have been somewhat neglected in comparison with the scientific and theoretical. There has been, perhaps, some justification for this in the belief that such aspects might be better acquired by experience than in the class room or laboratory. With the industrial tendencies of modern times, the keenness of competition and the advance of the economic to the front rank as a controlling feature in all industrial operations, the increasing importance of the practical side of the engineer's activity, can no longer be doubted. It becomes therefore nothing less than the plain duty of every engineering school to give not only such fundamental and theoretical training as shall familiarize the student with energy in its various forms, and with the means available for its transformation and adaptation to specified uses, but also to give him such fundamental and organizing principles regarding the economic uses of energy and its application to the needs of civilization, that his keenest enthusiastic attention will be directed to observations along practical and industrial lines.

Having in view the general facts above noted, it seems to follow that the typical engineer of the immediate future will be to an increasing extent a man of affairs, a man with some capacity and training in the administration and conduct of business and industrial enterprises, a man fully alive to the economical and practical aspects of his field of work; a man who is not only capable of transforming and using energy for the ends of industry, but a man who is capable of producing, with a given investment of energy, the largest practicable output of useful product; a man not alone capable of doing things, but of doing them in the most efficient manner. In fact, there are now awaiting men of such large capabilities, positions of wide responsibility and influence, and such men must necessarily enter into the world's work as a larger factor than the man who deals with a single aspect of his profession, necessary as the latter may be. It cannot be expected that every man will reach such positions of wide influence and responsibility, but as they are open to the engineer of proper capacity and training, the engineering college should surely take cognizance of such fact, and strive to give to the world men qualified for these positions.

The situation in brief is this. We have, on the one hand, the field of engineering industry,

and on the other the technical college occupied in the training of men for lives of activity and usefulness in this field. Are we sure that the instruction given, having in view both subject matter and mode of presentation, is the very best possible in its adaptation to the demands of the field of activity for which it is intended as a training? It is very sure that while the principles of engineering are unchanging, the practice of the art has during the past few years undergone most radical and important developments. Have the developments in technical education kept pace with these developments? We may be permitted to doubt it, and to urge that the one great need of technical education at the present day is a closer contact and more accurate adjustment with the field of engineering practice. We may say otherwise that the aim of the technical college should be to make its education more *practical* in quality, implying by this term not necessarily more handicraft skill, but rather a more carefully studied adaptation of its instruction to the present and immediately prospective demands in the field of practical engineering work.

Our suggestion to the colleges in brief is, then, a more careful study of the actual field of engineering practice, with a view of bringing about a more perfect adjustment between the demands in such field and their courses of instruction, both in subject matter and mode of presentation. The technical colleges have unquestionably played an important part in the development of our modern industrial position, but they have hardly yet measured up to their full possibilities of usefulness, and with a closer and more perfect understanding and adjustment between the colleges on the one hand, and those who employ their output on the other, a step forward might be taken toward the more complete fulfilment of the opportunities of the technical colege as a present factor in the world's industrial work.

ALL eyes are turned with absorbing interest now to the far east to follow the events of the naval struggle between Japan and Russia. At the beginning of the war the fighting fleet of Japan, exluding obsolete ships, consisted of thirty-three ships with a total displacement of 208,240 tons, while the fleet of Russia in the Pacific waters numbered thirty-one battleships and cruisers, with an aggregate displacement of a little over 200,000 tons. The Japanese fleet is composed of six 18-knot battleships averaging about 14,000 tons each; eight armored first-class cruisers of 9,300 tons each; eight second-class cruisers of 4,500 tons each; one 7,200-ton coast defense ship; eight third-class cruisers averaging 2,870 tons, and one gunboat. In comparison with this, Russia's Pacific fleet is made up of eight first-class battleships of about 12,000 tons each; four armored cruisers of 11,400 tons each; six second-class protected cruisers with an average displacement of 6,500 tons; five third-class cruisers ranging from 1,500 to 3,000 tons displacement, and seven gunboats. Besides these ships, each navy has a fleet of new high-speed torpedo boats and destroyers.

While in numbers the fleets about equal each other, the advantage lies with Japan, presumably for several reasons. In the first place, she has a homogeneous fleet of fighting ships. Her six English-built battleships are much alike, and six of her armored cruisers closely resemble each other, and represent the highest types of vessels afloat. The two smaller armored cruisers are described elsewhere in this number. Again, Japan is fighting in home waters, with an unlimited supply of coal near at hand, and is near her dock-yards; Russia has but a limited coal pile which can only be replenished from across the sea, and but partially-equipped yards at Vladivostok and Port Arthur, which are inadequate to maintain the fleet at the point of highest efficiency even in times of peace.

At last it is possible to form some adequate idea of the value of the torpedo boat. By a most daring and well-planned attack, Japan succeeded in disabling several of Russia's finest ships at the very outset of hostilities. In engagements immediately following at Port Arthur and Chemulpo several other Russian ships were damaged, or destroyed; thus the balance of sea power has been most assuredly placed with Japan. The Japanese naval officers and men come from a seafaring race and are, it is stated, fighting with unbounded enthusiasm with all the training of the recent China-Japan war. The Russian ships are commanded by men of great intelligence and undaunted courage, but the crews are made up, for the most part, of an inferior grade of men from the peasantry unaccustomed to sea or war.

Two conclusions may already be drawn, namely, the value of the torpedo boat, and the necessity of a fleet of fast scout ships for keeping in touch with the ships of the enemy.

OLD SCOTCH'S REVERIE.

BY C. A. M'ALLISTER, U. S. R. C. S.

"Old Scotch" was one of a battery of four modern steel boilers that generated the steam to run a 4,500-ton steamship engaged in the freight and passenger business on the Atlantic coast. Officially he was known as No. 1 boiler, from his position in the ship, being on the forward starboard side of the fire-room. Then, too, he was constructed about a month before any of his associates. From his priority of birth and his official position, he assumed the leadership of his brothers and became the spokesman of the generating branch of the machines assembled on that vessel. Realizing his importance, he was not at all backward in expressing his opinions in a general conversation among the members of that particular colony of metallic workmen, nor of chiding his brethren for dereliction of duty if such procedure became necessary.

Occasionally during the night, when everything would be quiet, he would muse over his past life and grumble about what he considered to be the hard lot of boilers in general. One night, shortly after the steamer had started out on a homeward bound trip, and Old Scotch was feeling quite satisfied with himself and everything else in general, he soliloquized as follows:

"Well, I think when I get back to New York this time I will have completed my 300th round trip. The company ought to give me a present of some kind or other, as I have not only furnished my share of the steam to turn that grouchy old Triple* back there in the engine room, but I have also kept these three youngsters in here with me going at full blast and made each of them do his share of the work. Further than that, I haven't cost the owners a cent for repairs, outside of a few dollars' worth of grate bars, furnace door linings, firebricks and such other knick-knacks that any well behaving steam generator is bound to use up in his daily toil.

"I have had lots of chances to kick over the traces and do myself damage, and some of these fine days, if this fire-room crowd doesn't do the right thing by me, I'll show them that I can act mean and perhaps give them as much trouble as that cranky old main engine. I am not so young as I used to be, and I need a little better attention than I have been getting. I will do my part all right, but when we get in port and they start in to clean me up, I expect these men to do it in a first-class manner.

"This coal they have been feeding me on lately isn't the best I ever tasted by any means. I heard the chief engineer say that the company bought it for a half dollar a ton less than the usual kind I have been getting. If they expect me to furnish as much steam with this sooty, clinkery old stuff as I did with that fine grade of coal, I'll simply fool them.

"Bah! it makes me disgusted to think of how my tubes and flues are getting stopped up with the soot from this stuff. Some of the time I can scarcely get my breath. If the old chief hadn't issued that order to blow out my tubes every other watch, I know that I would simply suffocate. I don't like that blowing-out business much either, but it is better than choking to death.

"That water tender by the name of Rourke knows how to clean tubes all right, but the other two fellows are not onto their jobs. They open my connection doors and take as much time connecting up the steam hose as if they were going to sprinkle a lawn. Every once in a while they let the firemen and coal passers indulge in a jawing match about who will clean the wing nest of my tubes, while all the time they have all three connection doors swung up and the cold air striking me on the front tube sheet enough to make my very tubes chatter. None of that business goes with Rourke. He has one nest of my tubes assigned to each man, and the hose all connected up ready for business before he allows them to raise a door. They then clean one nest at a time and do it in mighty short order, too, or that water tender will know the reason why.

"These engineers in charge of this ship don't seem to realize that we boilers, even if we are built of steel, need quite as much attention and care as a human being to get the best results from us. I often hear these firemen and coal passers kick like mules about the grub, as they call it, if it is not properly cooked or of the right sort. If they only stopped to think a bit, they would find that the quality of the coal they feed us on is just as essential to our good health as the food which they put into the stomachs is to theirs. We can't exactly growl, but we can soon show by the work we do that we don't thrive on poor coal. Then, too, it makes a great difference in the manner it is fed to us, just the same as their grub does to them. Many a time have I seen a new watch come into the fire-room just after they have gorged themselves and overloaded their stomachs at the dinner table. Mighty little work they do then for an hour or so, but sit around and smoke until their food gets digested. Yet they are the same fellows who fill up my furnaces to the crown sheets, slam the doors shut and expect me to make steam. Well, I have learned a lesson from them in that respect, as I simply loaf along and smoke, too, until the coal gets down so that I can burn it.

"Again, I have often heard them growl because the cook puts too much grease in their grub, yet they don't mind how much grease they put into my system in the feed water. I don't know just how grease affects their internal parts to make them look so disagreeable, but I do know that it makes me feel kind of queer when it settles around my tubes and crown sheets. Often I think that one of my crown sheets will surely collapse from the sickening stuff, and were it not for the fact that they occasionally rub it off while we are in port, I know that those parts of my anatomy would have given out long ago. Although they do get the grease off the tops of my furnaces, there are lots of places in my interior where the grease has settled that they don't attempt to clean off at all. I know from the way that I feel that the spaces between my tubes are pretty well chocked up with this horrid old stuff. I can't make nearly as much steam as I did when they were new and clean, as the heat simply won't pass through the tubes into the water.

"I heard the chief say not long ago that he supposed

* For the author's former article of engine room talk see Marine Engineering, November, 1903.

he would have to buy me a new set of tubes. So far as they are concerned, it is my opinion that if the men could only get up some way of cleaning my tubes off thoroughly, there wouldn't be any necessity of putting in new ones. However, I don't care so long as I can get a new set of bright clean tubes—of course, for my reputation for economy I would rather have the old tubes work along, but I am shown so little consideration of late that I am losing all of my pride.

"Only recently that new assistant engineer had the nerve to pump a lot of cold water into me when I was running along at my top speed and 'blowing off,' because that rickety old engine couldn't handle all the steam we were giving him. B-r-r-r—but it makes me shiver now to think of what a chill it gave me. Really, I felt so badly that I began to weep at every butt strap, and even at the very ends of my tubes. I do wish they would be careful and heat all the feed water that they give me in the future. I can't stand many more cold baths like that.

"And speaking of ill-treatment reminds me that only last night that water-tender Nelson got into a trance and left my main check valve wide open, so that the water rose inside of me clear over the top of my gauge glass. I tried to call his attention to it, but he was too busily engaged in 'chewing the rag' with an Irish fireman about whether Germany or the United States had the greater navy, to pay any attention to me. I stood it just as long as I could. Finally, when I got 'too full for utterance,' as I heard a man say once, I coughed up about two barrels of water into the main steam pipe. Well! maybe that didn't wake things up!! The first attempt relieved my pent-up feelings so much that I continued to cough up water for about ten minutes, and there was certainly 'something doing' aboard this old ship for a while. From the sounds which I heard coming from the engine room I imagined that I was being 'knocked,' as the saying goes, and that Old Triple was using his water hammer. That poor youngster Nelson was half scared to death. One moment my gauge glass would be full of water, and the next there wouldn't be any in sight. They opened my furnace doors and threw wet ashes over the fires. That rather cooled down my anger somewhat, and as I had already had considerable fun with them, I calmed down a bit—the water settled to about an even half glass in my gauge, and I could hear a large-sized sigh of relief coming from Mr. Water Tender. I'll bet that young fellow won't care who has the largest navy for a long time to come."

It is hard to tell how much longer Old Scotch would have continued his musings had he not been brought to life again by No. 4, over in the opposite corner of the fire-room, shouting out, "Wake up there, Pop, your fires are going out!"

"I'll 'pop' you, you impudent young scoundrel," retorted Old Scotch, now thoroughly aroused and angry. "You pay attention to your own fires, and I'll look after mine. If you only did half the work that I do, you wouldn't have to be stirred up with a slice bar every five minutes, like you have all this trip."

"That's all right, old man," snapped No. 4, " if I only had half as much of the draft that you are always getting I would never have to be punched with that old slice bar; you are simply the windiest old boiler that ever went to sea, and it's no wonder they don't have to use a slice bar on you."

After a few spiteful exchanges of compliments of this sort, things soon settled down to normal conditions again in the fire-room. Although Old Scotch cordially dislikes No. 4, he was, on the contrary, particularly friendly to his consort, No. 2, and they worked together without any friction or ill feelings. They exchanged confidences with one another and were often heard talking softly during the long mid watches through which they had passed together.

One night No. 2 whispered to his companion that he had not been feeling well for several days, and said that he knew he was in for a spell of sickness. When Old Scotch asked him to describe his symptoms he replied that it felt as if there was something gnawing at his vitals, and that he occasionally felt a sharp twinge of pain in the region of his furnaces. For a few moments Old Scotch was silent, as if engaged in deep thought; then, as if he had been a doctor and had just made a correct diagnosis of the case, he said, in a confident manner:

"Ah! I think I know what is the matter with you. You are getting a bad attack of galvanic action. The symptoms you describe are very similar to those I felt two years ago when I had a mild attack of the same disease, which has carried off so many of our most robust boilers. It is very insidious at first, but if it is allowed to go on it will wreck the very strongest boiler constitution. Now, I wouldn't advise you to consult any of these quack doctors when we get into port, for they will only fill you up with their patent compounds, and won't do you any good. What you need most of all is a good, large dose of zinc properly applied. By that I mean that it should not be thrown in your interior hap-hazardly, as is too often done, but it should be administered in small iron baskets clamped to some of your braces, and so arranged that the zinc will have a metallic contact with your body. With this treatment you will need occasional doses of salts (sal-soda) to keep the acid out of your system. Acid, you know, is what starts this disease, and after it has worn the mill scale off your surfaces, old galvanic action gets in his work very quickly. When they examine you, if they find any pits in your skin, you had better have them washed out thoroughly with a little soda, and then filled up with a little of that Portland cement salve. You won't look very pretty, but it will be much better than having your constitution undermined by this dread disease, which I suppose some humans would describe as boiler tuberculosis.

"Ah!" he sighed, "we boilers have our troubles, as well as do our masters. What, with fatty degeneration of the crown sheets, pitting of the vitals, corrosion of the skin, poor circulation, bronchitis of our air tubes, weeping of butt straps and other sinews, stoppage of the water pipes, dislocated checks, and so on, it is about all a poor old boiler can do nowadays to keep sufficient health to earn an honest living."

"Aw! go on,'" shouted out the impudent No. 4, who had been listening to the conversation. "Don't feel so

bad about it—forget it, or the first thing you know you will commence to weep again and then you will have to have one of those boot-legged calking tools shoved into your gills—that will make you grouchy for a month." Poor Old Scotch was too much overcome with the contemplation of the ills to which all boilerkind are susceptible to make reply to such unsympathetic remarks.

As they were now on their last day's run before arriving at their home port, speculation was rife in the boiler colony as to whether they were all to be given a general overhauling and a good rest or not. Poor No. 2 would occasionally wince with pain, and declare that if he had to make another trip without being doctored up he knew that he could not stand it.

After they arrived in port and the cargo had been discharged from the ship's hold, the superintendent made a general inspection of the vessel, and found her greatly in need of repairs. As she had been a good moneymaker, it was decided to haul her off for three months and make a thorough job of it.

All of the boilers were first given a good cleaning, the covering was stripped off and each given a fine painting of red lead. Old Scotch was found to need a new set of tubes, and he was therefore fitted with the best set of new seamless-drawn steel tubes that money could buy. No. 2 had all his pits treated, and No. 4, it was found, needed a soft patch in his back connections. This, as Old Scotch facetiously remarked, was necessitated on account of No. 4 being so lazy that he couldn't even keep his own back connections warm, and that in consequence they shook a hole in their sides. At any rate, when that family of boilers buckled down to business again they were as happy and contented a lot of steam generators as ever lifted a safety valve.

Old Scotch did very little growling, and with his new set of tubes was more the monarch of the fire-room than ever before. As they were passing out by Sandy Hook on their first trip since being rejuvenated, he remarked to No. 2: "Say, partner, if these fellows in charge of us only treated us a little more like human beings, we wouldn't cost them so much money for repairs. Eh? It's man inhumanity to boilers that hurts."

QUERIES AND ANSWERS.

Q. 195.—Would you please answer the following in your next number:

I am engineer of a steamer with the following: engine, compound, surface condensing, 14 and 28 by 22 inches stroke, carrying steam at 110 pounds gauge or 125 pounds absolute. Engine turns 136 revolutions per minute with an 8-foot 6-inch pitch of wheel; a 3-inch rudder post of round iron is replaced by one made of wood 10 inches square and only 3 feet 4 inches from the after side of the propeller. The boat draws 8 feet 6 inches of water when not running, but at full speed draws 10 feet 6 inches. Before the change she would steam 10 knots at 136 revolutions per minute, and afterwards only 9 1-4 knots, the revolutions being the same. I claim it is the post that does the harm. Will you please give me your opinion of the matter, and would there be any benefit in putting a feed coil in the exhaust of the low-pressure cylinder, the exhaust being from 5 to 10 pounds gauge and 24 inches. I get a feed temperature of 120 degrees and would like to increase it if possible by having a coil in the exhaust. What length or area of tube surface would be required and what degree of heat would be given to the water supposing it to be 120 degrees on entering the coil? Would you also be kind enough to inform me if there is any mechanical power gained by having the feed water heated by live steam from the boiler, and if not, why? L. W.

A.—A falling off of three-fourths of a knot in speed seems to be a serious loss to charge against the fitting of a new stern post; still, the substitution of a square post ten inches on the side for a round post three inches in diameter would undoubtedly introduce a serious drag at the stern. Your proposition of putting a feed coil in the low-pressure exhaust is of doubtful utility. Your statements regarding the pressure of the exhaust and the vacuum are not quite in agreement. If you are able to carry 24 inches vacuum the exhaust pressure in the cylinder should not be over five pounds. With this pressure the temperature would be somewhere about 160, and you could, of course, readily heat up your feed water to some extent. In order to make any such arrangement reasonably effective, however, a coil of very large size would be required. It would be, of course, entirely out of the question to place any such coil in the present exhaust discharge, as you seem to suggest. Any such attempt would simply block the discharge, and result in a most serious increase in the back pressure.

The only way in which you could arrange matters satisfactorily would be by passing the exhaust through a regular feed-water heater on its way into the condenser. By this means, and with a large heater, you could probably raise your feed to something like 140, and this would of course represent a direct gain. It may be questioned, however, whether you could not do better with a smaller heater into which you could lead steam from your auxiliaries, pumps, etc., such exhaust having a much higher pressure and temperature, and thus giving you a much more vigorous action on the feed water.

There is no direct gain, in terms of heat, in using a heater provided with steam direct from the boiler. You can easily see the reason of this by noting the fact that the operation as a whole involves simply the taking of heat out of the boiler in the steam which is used and putting exactly the same amount back again in the feed water which is heated up. It is simply an even exchange, and, omitting loss due to radiation, the transfers of heat in the two directions would exactly balance off, and there would be left neither gain nor loss. Actually we might expect some slight loss from radiation. It does not follow, however, that the use of such a feed-water heater may not be on the whole desirable. Many engineers believe that hot feed water is very much easier on a boiler, and that the operation of a boiler is more uniform and possibly more efficient when fed with water as near the temperature of vaporization as possible. These considerations have relation primarily to the operation of the boiler and engine, and independent of the question of any actual gain or loss in terms of heat units, may amply justify the use of a feed heater of the kind mentioned. Usually, however, the best all-around results may be obtained by using a heater of size suitable to the work in hand, and leading to it the exhaust from the various auxiliary engines and pumps, by which means you should be able to raise the temperature of your water to somewhere between 160 and 200, or possibly even higher. The amount of surface suitable may be taken as about one square foot of brass tube surface for from four to six I. H. P.

Q. 196.—Will you kindly advise me the thrust, in pounds, on propeller, for vessels of 600 horse power and 12 knots speed; also advise how it is calculated, and whether the thrust is greater if the vessel runs slowly than it is if it runs faster?

E. A. R.

A.—The thrust is calculated in this way. The thrust power is the power represented by the work done at the thrust block, and is measured by the actual thrust multiplied by the speed. Now, with fair propeller efficiency, the thrust power will average about two-thirds the indicated power, or in the present case, about 400 horsepower. This is therefore the product of the thrust by the speed in feet per minute. Hence we have for the thrust the following expression:

$$T = \frac{400 \times 33{,}000}{12 \times 101.3} \text{ pounds.}$$

This figures out slightly less than 11,000 pounds, but due to the fact that the 400 was no more than an estimate of the thrust power, we may take in the given case 11,000 as a fair estimate of the thrust in pounds.

Since we divide the thrust power by the speed to obtain the thrust, it is clear that for a given power the thrust will increase as the speed decreases. Thus at 6 knots with the same power as in the present case the thrust would be twice as great, or about 22,000 pounds, while at 24 knots and the same power it would be only one-half as great, or about 5,500 pounds. Of course these various conditions could not exist with one and the same boat. They simply show the values of the thrust which would correspond to 600 I. H. P. at the various speeds mentioned.

PERSONALS.

Robert S. Hubbard has accepted the position of superintendent of steel hull department with the Townsend-Downey Shipbuilding Company.

George C. Cook, naval architect, has changed his address from Water street to 52 Broadway, New York, N. Y.

M. P. McDonagh, who formerly held the position of inspector of hull and material (special mechanic), Navy Department, at the works of the W. R. Trigg Company, has resigned and accepted a similar position with the United States Engineer department at the works of G. A. Gilchrist, Belfast, Me.

F. Miriam Wheeler, manager of the marine department of the George F. Blake Manufacturing Company, New York, N. Y., is about to retire on account of impaired health. For thirty-four years Mr. Wheeler has been engaged in the pump business.

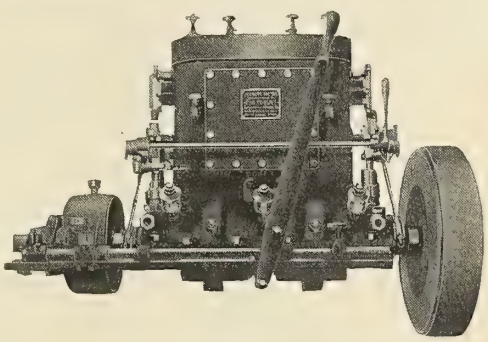
Harry R. Cobleigh, formerly connected with the advertising department of the Crocker-Wheeler Company, Ampere, N. J., has undertaken the duties of mechanical editor of the *Iron Age*, New York, N. Y.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 46 vessels of 13,992 gross tons built in the United States and officially numbered during the month of January, 1904. The largest steel steam vessels included in these figures are the *Duluth*, 4,623 gross tons, and the *Père Marquette 14*, 2,531 gross tons.

ENGINEERING SPECIALTIES.

The Toquet Motor.

One of the smaller gasoline marine motors which has met with marked favor is that manufactured by the Toquet Motor Company of Saugatuck, Conn. The reason of its success is, it is claimed, due to the fact that the motor is well designed and that none but the best material and workmanship enter into its construction. This motor is a 2-cycle one and all sizes, down to the smallest 3-horsepower size, are built with two cylinders. Both cylinders are in one casting, which insures a perfect alignment to all working parts. It is fitted with an inside reverse gear and governor, which makes it extremely easy to handle; is only 11 3-4 inches from center shaft to the top of the polished brass cylinder head, and about 30 inches in over-all length including reversing gear. It is claimed that the engine runs as smooth as a sewing machine. It is built very light and yet the metal is so placed that strength and durability are not impaired. The small size is specially adapted to canoes, skiffs, and small auxiliaries.



SMALL 2-CYLINDER GASOLINE MOTOR.

The larger sizes, of 5 and 8-horsepower double-cylinder motors, are of the same design and grade, and, it is stated, that on account of their light weight they are displacing rapidly the heavy machines of the more common type. By means of the double cylinder the vibration, a very marked objection to the single-cylinder motor, is overcome. Two special features of this make are the proper lubrication of the crank pin, which is not to be found in many 2-cycle types, and, second, eliminating the difficulties of poor contact. The rocker arm of the movable electrode in this motor is so arranged and constructed that it is always kept cool and thoroughly lubricated.

Combined Reamer and Countersinking Tool.

In steel shipbuilding, the reaming and counter-sinking expense is no small item. The present method, which the Luckhurst tool, herewith illustrated, aims to supersede, involves two sets of operators; the first consists of two workmen who, with an air motor, ream the hole, and they are followed by a second gang doing in like manner the countersinking. With the Luckhurst combined tool fitted to a motor, the two workmen first ream the hole and then simply lower the motor until the

countersinking part of the tool takes effect, the motor never necessarily ceasing in its turning from the beginning of the reaming until the countersink is complete, the time consumed in passing from one operation to the other being practically *nil.* Since the new tool accomplishes both duties by one operation, eliminating the shifting of tools and time taken up by twice covering the same ground, a great saving is made of labor over the double gang arrangement, a saving, it is claimed, of 33 per cent.

But this saving to the builder must not be considered the tool's only accomplishment. It will appeal to prospective users mainly in its assuring at all times a countersink concentric with the rivet hole, for the intermediate neck on the tool guides the countersink and

A COMBINED REAMER AND COUNTERSINKING TOOL.

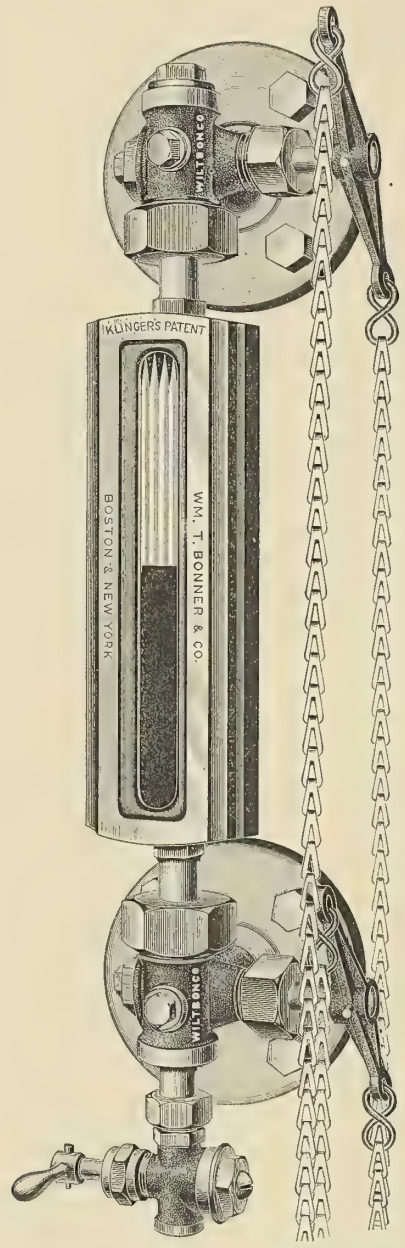
determines perfect work. The countersink angle can at no time be eccentric to the opening. The time lost in cutting out condemned rivets and reriveting is the most provoking part of hull erection, and the loss in money on a large ship amounts to several thousand dollars. By actual demonstration this combination tool has shown that the cutting out of rivets is so small as not to be considered.

The tool has already met with government use and endorsement, and is in daily use at the New York Shipbuilding Company's plant, the Maryland Steel Company's ship yards and others. Captain Allen Luckhurst, of Philadelphia, is the inventor and patentee and The Scully Steel and Iron Company, Chicago, sole manufacturers and sellers.

Reflex Water Gauges.

Marine engineers generally have observed with keen interest the progress of the first flotilla of United States torpedo destroyers from Norfolk to the Philippines, via the Suez canal. After leaving San Juan the flotilla was at sea for two weeks until Cape Verde islands were reached. The longest single run covered by the itinerary was about 2,300 miles, the total length of voyage being something over 18,000 miles, and the time required was but 15 weeks, while that according to schedule was about 5 months.

Before starting on this voyage the *Bainbridge, Chauncey, Dale, Barry,* and *Decatur,* the five destroyers constituting the flotilla, were thoroughly overhauled and refitted at the Norfolk navy yard, and great care was

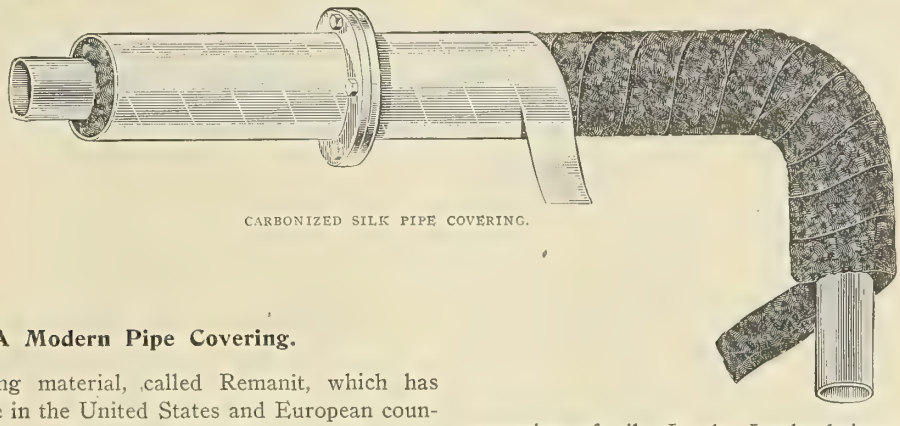


PATENT WATER GAUGE AND GAUGE MOUNTINGS.

exercised in the selection of such devices and equipment as could be counted upon with absolute certainty to insure the safety of the ships in all kinds of weather, and for unlimited periods of time during which they might not be able to put in at any ports for repairs. Naturally special care was given to the engine and boiler mountings, and the engineer officers were all of one mind in demanding the installation of water gauges which they

knew would be perfectly reliable. The accompanying illustration of the Klinger reflex water gauge and Wiltbonco gauge mountings has been reproduced from a photograph of one of the actual outfits as supplied by the manufacturers, Messrs. William T. Bonner and Company, of Boston and New York, to each of the boilers on the five ships named.

The special feature of this gauge is the facility with which the water level can be determined at all times, even though the gauge be located in a dark corner where the ordinary water glass would fail to show whether the gauge is full or empty. When filled with water the reflex gauge always appears black, as though it contained ink. When empty it shows a silvery white. This effect is produced by the peculiar shape of the observation glass, which is cut on the inner surface with prismatic grooves, thus preventing the rays of light from passing through until such time as the grooves are filled with water. It then becomes transparent and one can see through the glass and the water the dead-black background of the chamber inside.



CARBONIZED SILK PIPE COVERING.

A Modern Pipe Covering.

An insulating material, called Remanit, which has been in service in the United States and European countries for a number of years, is very different in structure, and in the method of applying, from any other form of covering. In a series of elaborate comparative tests made with this and other pipe coverings the results showed Remanit to be the most efficient of all. The best pipe covering is the cheapest, as pipes, especially steam pipes, are covered to reduce radiation and thereby save coal.

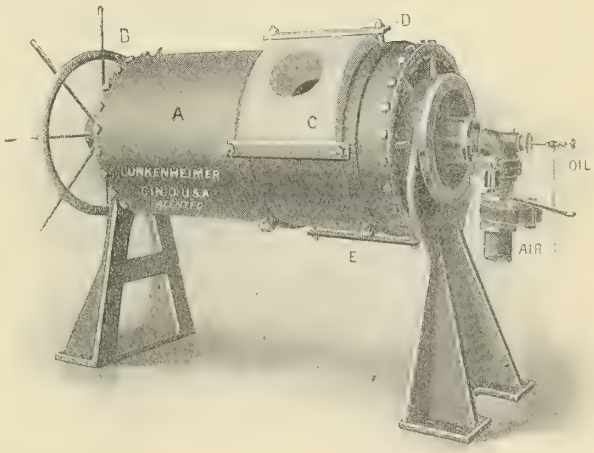
The covering is made of carbonized silk, which is an exceptionally poor conductor of heat. It will not deteriorate; fits any size of pipe or fitting; is lighter than other coverings; is easily applied or removed; is moisture-proof, and protects the pipe against rust. These are some of the advantages claimed for this covering.

As will be seen from the cut, the method of applying is very simple. It consists of wrapping the material, which is made up in flat strips, around the pipe. An outer covering is then wound around in the opposite direction and the work is complete. The flexibility of Remanit for working around elbows and fittings is very evident. It is adapted for use on steam pipes, hot-air and hot-water pipes, lagging cylinders, cold-water pipes, tanks, gas pipes, refrigerators, ice boxes, wood and iron buildings. This material is handled by Emil Frank, 1127 Broadway, New York, N. Y.

New Metal-Melting Furnace.

The metal-melting furnace here illustrated was designed after experimenting with nearly every type of furnace on the market, and is found to afford a very efficient method of melting metals, especially brasses and bronzes. As will be seen from the cut below, the furnace consists of a cylindrical sheet-steel drum *A*, having cast-iron heads. The interior of the drum is lined with fire-proof tile, and there are two openings on opposite sides of the drum. Only one of these openings is in use, the other being closed by a fire clay filling. The object of having two openings is to increase the life of the linings of the furnace. It has been found that the furnace wears out sooner around the filling hole (which also serves as outlet for the flame) than elsewhere. The advantage that this furnace has over all other makes is that when one filling hole is worn out this can be closed by a fire-clay filling and plate, the furnace reversed, and the other hole cut out and put in service.

The oil burner is of a special type, designed to give the greatest amount of heat with a minimum consumption of oil. In the Lunkenheimer foundry there are ten of these furnaces in use, and they are able to



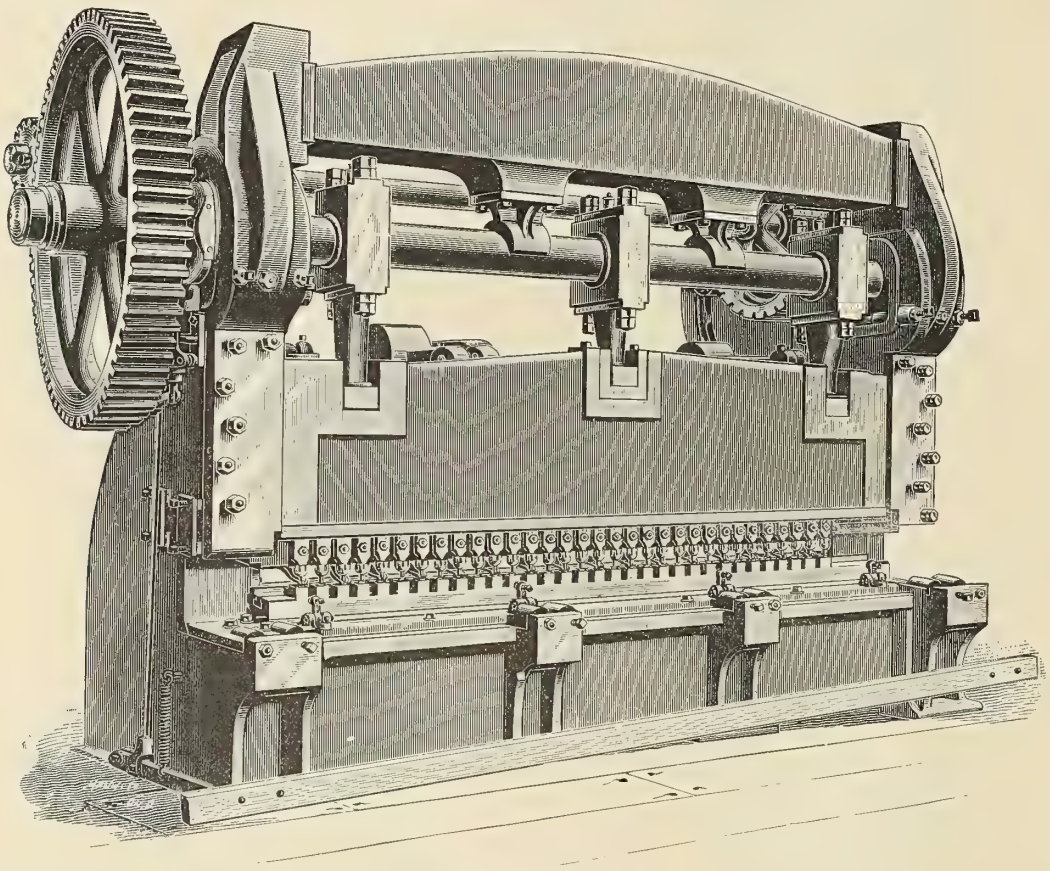
A NEW METAL MELTING FURNACE.

secure from six to seven heats per working day of ten hours from each furnace. The weight of each heat will average about 550 pounds, and the oil consumption

varies from 2 to 2 1-2 gallons of crude oil per 100 pounds of metal melted.

The life of the linings is from 300 to 400 heats, this varying due to the kind of metal melted. The whole furnace is of a heavy and substantial construction, and will be found very durable. On account of the simple form of the tile it is very easy to re-line, an objection which was found in some other types of furnaces. This furnace is made in two sizes, one with a capacity of 550 pounds of metal per heat, and the larger size having a capacity of 1,200 pounds of metal per heat.

The manufacturer, the Lunkenheimer Company, Cincinnati, O., sends an expert with the first furnace sold to each customer within 1,000 miles of Cincinnati, to start the furnace and take off the first heat and instruct the furnace-room employees how to secure the best results in handling.



DOUBLE-GEARED POWER MULTIPLE PUNCH.

A New Multiple Punch.

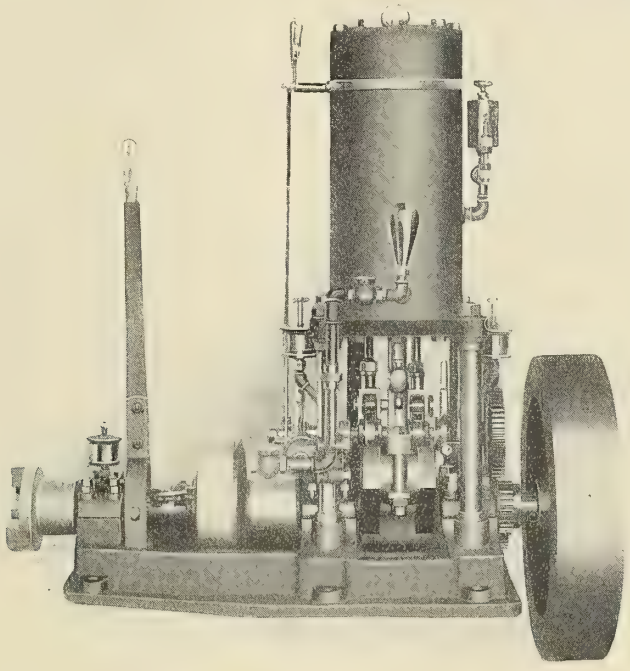
The illustration above is of a heavy double-geared power multiple-punch machine of new type for punching a series of holes through plates up to 3-8 inch thick and 9 feet long. This machine is massive in all its proportions, hence capable of heavy duty without undue straining. The hammered steel cam shaft is, as shown in the cut, of triple throw, that there may be no springing in the center when the punch is working to its designed capacity, and above the shaft there is a supporting arch with two bearings which further contribute to its rigidity and strength.

The main bearings of the cam shaft are enclosed in the main housings, instead of there being half boxes bolted on top, thus there are no bolts to work loose from the continued up-thrust of the gate. These journal boxes have an adjustable wedge seat for taking up the wear of the shaft. The arch is inserted at the ends in the housing, instead of being bolted on top, and for the reasons similar to those above. The pendulums are made so that adjustment is obtained for the punches as they wear shorter.

The gate is extra high, hence has extra long bearings at the ends, insuring accuracy and reducing the breaking of punches to a minimum. There is also a center bearing at rear of the gate to stiffen it and preserve perfect alignment. Each punch and die holder is separate and adjustable for different intervals. The clutch is steel faced, the gears are extra heavy machine mold and the clutch slides on main shaft which is square at the clutch point, hence there are no key ways to weaken the shaft or keys to make the clutch stick. The machine may be arranged for belt, engine or motor drive and may be also used for shearing. This machine is built by the Cincinnati Punch and Shear Company, and handled in the East by The J. R. Vandyck Company, of New York and Philadelphia.

Marine Engine for Heavy Work.

The Lacy four-cycle marine gasoline engine, here illustrated, is of 15-horsepower, and was specially designed for working boats and small tugs. It was built with great care and of the best materials, and, it is claimed, has all the essentials for long life under hard and continuous service. The most striking feature of this engine is the absence of the crank case, as the engine is the four-cycle type, compression takes place in the cylinder itself. All the lower portion of the engine is, as will be seen in the illustration, exposed for the engineer's inspection. A loose bearing may be readily detected and quickly adjusted, for all bearings and every nut are accessible and require no special tools or wrenches.



4-CYCLE MARINE GASOLINE ENGINE.

Very liberal bearing surface is allowed throughout. The exhaust and inlet valves are exceptionally large in diameter, thus allowing short lift, and thereby increasing the life of the entire valve gear. Ignition is by the jump-spark system, which the builders have found to be the most reliable and satisfactory method. The speed of the engine is at all time under perfect control of the engineer, whether pulling full load or running light. A feature which warrants special consideration is that the engine may be installed in any cabin boat without in any way mutilating the cabin. Although it is a large heavy machine, it may be taken apart and shipped on board through a hatchway or window of 15 by 30 inches. Any of these engines, up to and including 60 horsepower, will go into a cabin boat through the ordinary doors. The dimensions of the bedplate for the 15-horsepower machine are 48 by 28 inches, and the height of the engine over all when assembled is 52 inches, the weight is about 1,500 pounds.

The builders of this engine, the Lacy Brothers, Toledo, Ohio, also make engines of the two-cycle type in sizes from 1 1-2 to 40 horsepower, which are specially designed for light, high-speed service.

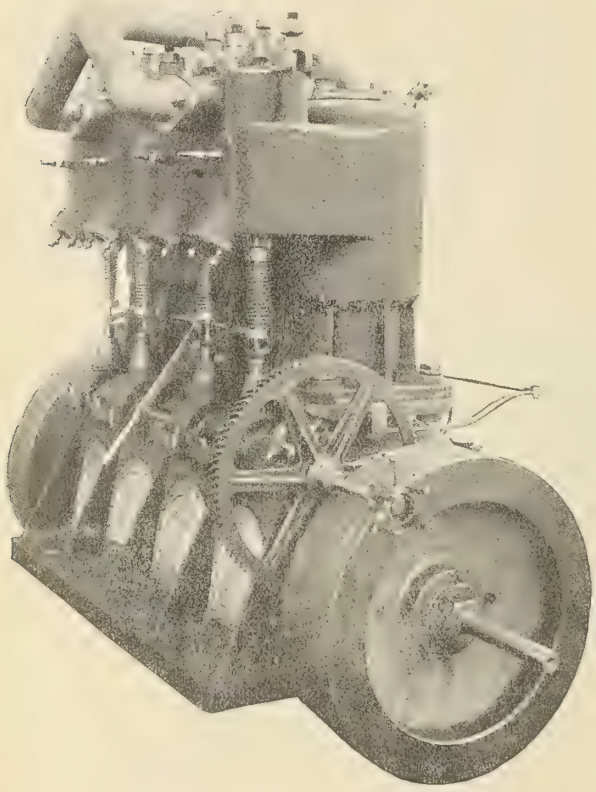
Adami Marine Gasoline Engine.

The engraving on the next page shows the gas engine fitted on board the launch *Espero,* built by Messrs. G. Adami and Company at Virenze, Italy. Simplicity, strength, light weight, and high efficiency are the features observed in developing this motor of large horsepower. As will be seen in the cut, there are two pairs of cylinders, with two cylinders in each pair, cast together. The cylinders are of four-cycle type. The base is of cast iron, in one section, with hand plates in front of the crank for getting at the connecting rods and crank shaft when necessary.

While there is a direct system of lubrication leading to large bearing, the moving parts are also lubricated by the cranks dashing through an oil bath at the bottom of the bed casting. The crank shaft is of forged steel supported by five hard bronze bearings, and the connecting rods are also of forged steel of double T-section.

While it was intended to run the motor at about 400 revolutions, the speed of 1,000 revolutions was reached without difficulty and without abnormal vibration. From indicator card it was found that the maximum compression pressure was 95 pounds, while the back pressure was but 4.4 pounds per square inch. The cylinders are 8 inches in diameter by 8 5-8 inches stroke, yet the engine is easily started by hand. The valves are operated by a gear-driven shaft on the front of the engine,

as seen in the illustration. The carburetor is at the back of the engine, a mixture of gas oil coming up through the pipe over the center of cylinders.



ITALIAN 2-CYLINDER, 4-CYCLE MOTOR.

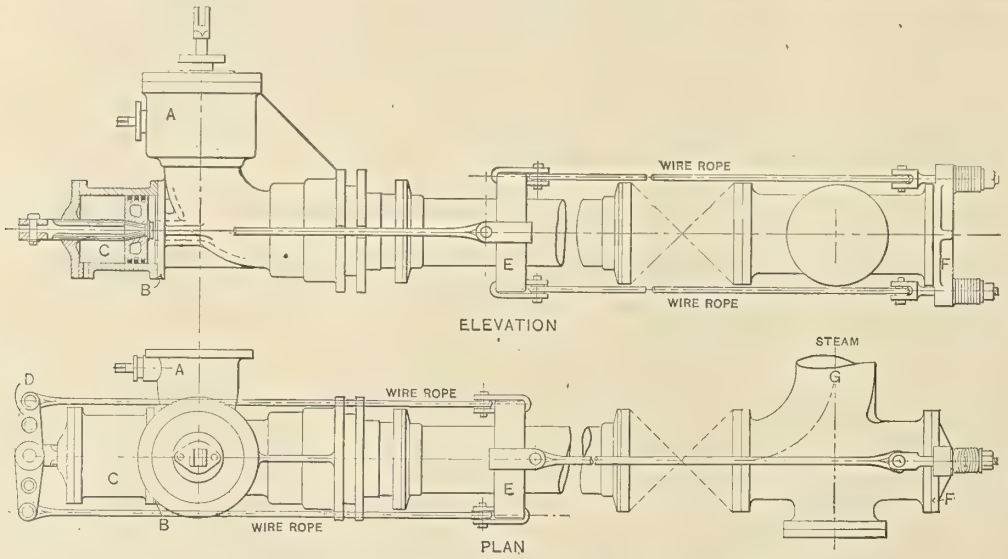
The *Espero* is 50 feet long and draws but 39 inches of water. At an engine speed of 400 revolutions the boat is driven at a 13-knot rate, about 70 I. H. P. being developed. When running at maximum revolutions 108 horsepower is claimed to be indicated.

Balance Cylinder for Steam Pipes.

In view of the importance which the subject of steam pipes on board ship was given at the recent meeting of the Society of Naval Architects and Marine Engineers, the balance cylinder for the main steam pipe, patented by Robert Sproule, consulting engineer, 205 Huxbridge Road, London, West, is of special interest.

In the case of a large steamship careful observation with full steam pressure and boiler stop valves open, showed movements of the main steam pipe varying from 1-4 to 1 7-16 inches, while the bulkheads to which they were anchored showed movements varying from 1-32 to 3-16 inch, which shows the stresses and strains which have to be taken, first by the boilers and engines, and ultimately by the hull. The means by which both machinery and hull may be relieved of this strain are seen in the device illustrated herewith, the steam from the boilers entering the fitting at the right hand at the point *G*, the throttle of the engine being at *A*.

The balance cylinder is used in conjunction with the ordinary slip expansion joint, and it comprises a regulator valve *A* of the ordinary type, except that it has a facing surface *B* cast on it with an opening through it as shown in dotted lines. On *B* is bolted a cylinder *C*, having a bore equal to the external diameter of the steam pipe. To the cylinder is fitted a piston with a stout cast-iron rod, to which is attached a swinging cross head, *D*, from each end of which wire ropes are carried to the ring *E*, to which they are attached by shackles. Similar wire ropes are brought from *E* and connected by coupling bolts to lugs on the blank flange *F*. The action is as follows: When the boiler stop valves are opened the steam passes along the main steam pipe and through the opening in *A* into *C*, forcing the piston out and putting a tensile stress on the wire ropes, which stress they transmit to the blank flange *F*, on which the internal and external pressures now balance each other. The main steam pipe is now in a state of perfect equilibrium and flexible, in the sense that it can give freely at the expansion joint with the

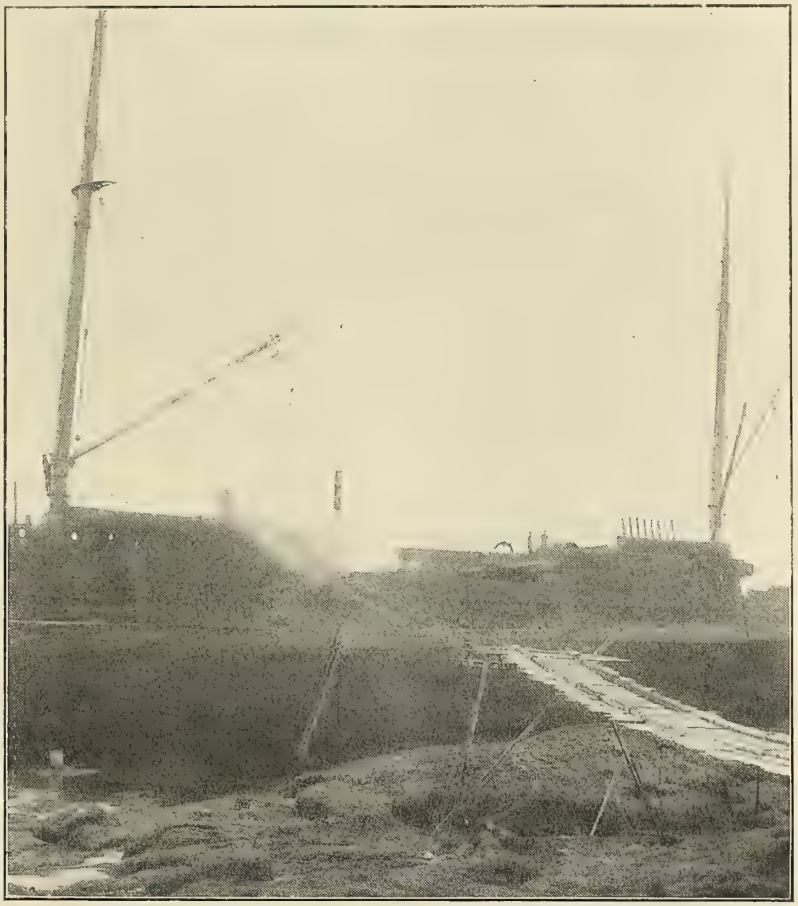


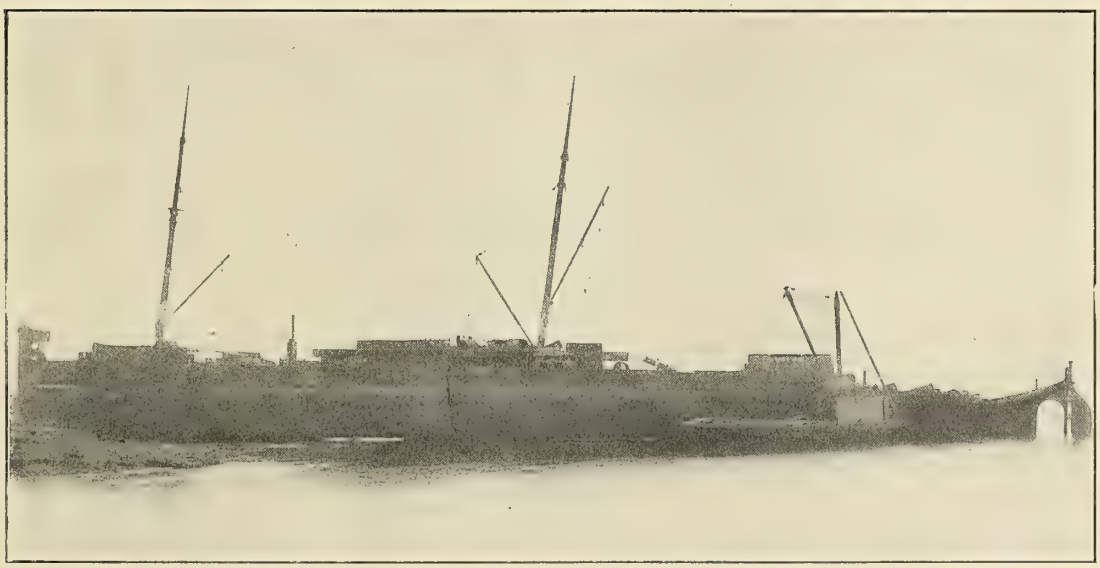
CYLINDER FOR BALANCING STEAM PRESSURE IN A STEAM PIPE.

working of the hull in bad weather. There is no force tending to cant the boiler stop valve, and a further advantage is that the bolts at the flanges of the pipe are relieved of all tensile stress due to the steam pressure. By interposing springs, as shown at *F*, the shock in case of waterhammer in the pipe when starting would be cushioned.

The Steamship Lake Superior Wrecked.

The total loss of the steamer *Lake Superior*, following accidental grounding in the harbor of St. John, N. B., is another illustration of the serious damage a ship may sustain whenever she comes in contact with anything but her native element.





STEAMSHIP LAKE SUPERIOR, BEING BROKEN UP IN THE HARBOR OF ST. JOHN, N. B., WHERE SHE WAS WRECKED.

A pilot was taken on board the *Lake Superior*, of the

Elder-Demster Line, as she entered the port bound from Liverpool, on March 28, and it was decided to bring the ship to anchor in the upper quarantine station. The tide had been flowing ebb for one hour and a half, but the vessel easily proceeded to the spot where it was intended to moor her. Her engine was stopped and the starboard anchor dropped, but the vessel was caught on the port bow by the very heavy tide and carried broadside on to Round Reef. Six tugs failed to float the steamer on following high tide and several other attempts all proved futile. At each outgoing tide the vessel was left so high and dry on the reef that her bottom was badly damaged. Cargo, coal, and all removable equipment was lightered ashore, and she was finally floated, but the hull was found to be in such a damaged condition that the steamer was sold at auction. Miller and Company, of Boston, bought her for $26,500 for scrap, so the vessel was beached at high tide and broken up, in the course of which operation she is illustrated. The removal of the upper plates weakened her to such an extent that she broke in two, as shown in the engraving, just aft of the midship house. The means of getting the material ashore was by a cable railway, the cables made fast to the masts of the ship and to the rocks on shore.

Electric Club Journal.—A new magazine, entitled the *Electric Club Journal,* appears in February of this year. It is published by the Electric Club of Pittsburg, Pa., which has been organized to provide a means for effective co-operation among Westinghouse men. In the prospectus of the *Journal* the editors state that articles will be made up chiefly from selections from the technical proceedings of the club. The magazine is paper bound, containing 54 pages of reading matter, is 6 by 9 inches. The subscription price is $1 a year, or 15 cents a copy.

Japanese Gunners.—In an interview with the *Daily Mail's* Seoul correspondent, Brig.-Gen. H. T. Allen of the Philippine constabulary, who was appointed to accompany the Russian army, and who watched the naval fight at Chemulpho at close quarters and afterward rowed around the Russian ships before they were destroyed, said:

"I have never seen or heard of anything resembling the effect of the shrapnel fire. The *Variag* was literally peppered in parts as though she had been played on at close quarters with machine guns. Evidently time fuse shrapnel was used with blinding, bewildering effect.

"The heavy artillery work emphasizes the fact that you fire a tremendous lot and get little for it. The firing lasted fifty-two minutes and there were ten shots a minute. Only two heavy shells struck the *Variag's* hull. One shot exploded on the bridge and strikingly demonstrated the effect of shell fire, everything around being torn to tatters and resembling the debris of a machine shop. All the torpedo tubes were filled after the fight, indicating that none had been fired.

"The Russians knew evidently that they were going to inevitable death, yet they fought until their ship was unmanageable. Their commander did well to bring the ship into the harbor. Further fighting would have been madness."

TECHNICAL PUBLICATIONS.

Supplee's Mechanical Engineer's Reference Book. By H. H. Supplee. Size 4 by 7 inches. Pp. 834, with numerous diagrams and cuts. Philadelphia: J. B. Lippincott Company. Price $5.00 net.

The publisher's announcement that an engineer's hand book was in preparation by the author of this work has naturally led to keen expectation as to the ground to be covered and as to the general character of the subject matter to be included. It is naturally necessary, in preparing such a book, to select from among a great mass of detailed information such individual features as shall be the most generally useful to the engineer in the daily exercise of his profession. It becomes thus in large measure a matter of judgment with the author as to what shall be included and what excluded; as to what will be most useful in the everyday work of the practical and designing engineer, and as to what will be so rarely needed as not to justify its inclusion. Considered from this view point the author seems to have used excellent judgment and to have produced a well-balanced compendium of useful information for the daily needs of the engineer. As the author points out, the presentation of a mass of formulæ or data, without selection, and perhaps, to some extent, internally contradictory, tends to confuse the user and to throw upon him the burden of a choice where he is looking for more definite guidance. To avoid this so far as possible the author has examined the many and varying formulæ relating to engineering practice, and has given only those which, in his judgment, are most generally applicable to standard and average conditions.

The subject matter is presented under the general heads: Mathematics, Mechanics, Materials, Design, Heat, Air, Water, Fuel, Steam, Steam Boilers and Engines, Internal Combustion Motors, Electric Power, Cost of Power, Works Management.

Under mathematics and mechanics are found the usual formulæ, mathematical tables, etc. The conversion tables for English and metric measures are especially full, and the sections dealing with trigonometric formulæ and with differential and integral calculus are more extended than those usually found in handbooks of this type. The section devoted to materials includes the engineering properties of the various materials employed, together with a large number of tables giving weights, standard dimensions, and mechanical properties of classified materials of every description. Under machine design we have presented a wide selection of formulæ and methods for determining the dimensions and proportions of fastenings, bearings, shafting, gearing, pulleys, belting, engine details, etc.

Then follow sections of the book taken up with subjects relating to heat and the transformation of heat energy into mechanical form. The sections relating to fuels, steam, boilers, engines, and internal combustion motors are well stocked with useful tables, data, methods of computation, discussion of indicator diagrams, heat losses, results of tests, etc. The section on electric power contains the usual useful tables and data, and gives also the rules of the National Electric Code for wiring. There is given also a most interesting collection of tests of motors used for individual tool drive.

including description of work done, power required to run machine unloaded and when under full load. The section on the cost of power gives much valuable data regarding the cost of power developed from various sources and under various attendant conditions. An interesting addition to the usual contents of books of this character is found in the section on works management, giving in outline the fundamentals of organization and cost accounting for industrial establishments.

In the appendix are placed some miscellaneous matters not elsewhere located, among which is a table for powering steamships taken from Nystrom's handbook. The utility of this table, except as a crude approximation, may be questioned. The power is given in tabular form for regularly varying values of the displacement and speed, but quite independent of the characteristics of form. While for certain rough purposes such information might have some value, yet the power so depends on form and other special conditions that any dependence on the values thus given might be most disastrous, and it is doubtful if they should be given the semblance of reliability and value by printing them in a book of this character.

As a whole this handbook should take a leading position among like publications in the engineering field, and its many excellent qualities are most cordially commended to all engineers.

The book is published in the best style of the technical printer's art: semi-flexible leather covers, gilt edges, marginal index of main heads, excellent paper, and general make up, with good type and clear cuts and illustrations.

History of American Steam Navigation. By John H. Morrison. Size 6 by 9 1-2 inches. Pp. 630, with numerous illustrations. New York, W. F. Sametz and Company. Price, delivered, $4.25.

The purpose of the author in the preparation of this book has been to give in somewhat full historical detail the development of steam navigation in America, with especial reference to the coast and inland waters of the United States. Of the 12 chapters the first one relates to the experimental period, covering the time down to, presumably, 1825 and including an interesting resumé of the efforts of Fulton, Stevens and others in the earliest days of steam navigation. Chapters two to seven inclusive relate to the development of steam navigation in its various phases on the coasts, sounds, bays, lakes and inland waters of the United States. Chapter eight deals with ocean steamship lines, and with the larger coastwise lines not previously mentioned. Chapter nine deals with the development of ferries and tug boats, chapter 10 with the advance in speed, chapter 11 with the development of aids to navigation, including lighthouses, lightships, fog signals, steamboat inspection service and the life-saving service. Chapter 12 gives a brief history of the improvements at Hell Gate, resulting in the greater safety and facility of navigation through this crowded waterway.

There has been no attempt to give a complete history of every line of steam vessels, and many of the early records are necessarily somewhat uncertain. So far as the vessels described are concerned only those having some historic interest and embodying distinct features in hull or machinery, speed, carrying capacity or further item, giving to them some right of prominence in the historical development of the era, are described. Great effort has been made to obtain accuracy in matters of detail, but previous to 1870 completeness of detail or full accuracy is not always practicable. Since that date the journals devoted to engineering and to maritime interests furnish a basis for more accurate statements. In matters of history much is necessarily referred to the judgment of the author, and the author's personality is sure to enter to a considerable degree. In the present case it is probable that many of his statements will not be acceptable to the views of some who have formed their own opinions regarding the historical development of navigation in America, or who may be intimately acquainted with special details which may have escaped the author's notice. As a whole, however, the work seems to have been carefully and conscientiously done, and will be found of great interest and value to those who are concerned in the historical branch of the subject.

The book is well printed and the illustrations have been carefully prepared from the most reliable prints extant, and may be accepted as accurate representations of the vessels to which they refer.

The Polar Planimeter. By J. Y. Wheatley. Pp. 114, with 10 diagrams in the text and 12 folding plates. New York: Keuffel and Esser Company. Price $3.00.

The purpose of the author in preparing this work was to fill a want which he had himself met in connection with the use of the planimeter for engineering purposes. While much has been written on the theory of the instrument, there seemed to be no comprehensive and practical work dealing with the instrument as an engineer's tool, and giving the needed instruction regarding its adjustment and use. This need the author has endeavored to supply. The subject matter is presented in ten chapters dealing with the construction and theory of the instrument and with its use in dealing with a wide variety of engineering problems. The theory of the instrument is given without the aid of the calculus, and in a manner sufficiently simple to be followed by all who have an elementary acquaintance with algebra, geometry and trigonometry. The engineering applications are discussed under the general heads: measurement of areas, problems involving averaging, and the measurement of quantities of materials. These various applications are discussed in great detail and the various steps are fully discussed and clearly explained.

The treatment includes also very complete tables of factors and other data for the adjustment of the instrument, thus adding to its value as a complete office handbook for the adjustment and use of all instruments of this type. A chapter is also given on the various kinds of modern planimeters, their construction, adjustment, and use. In the closing chapter the general subject of accuracy, absolute and relative, is considered, and the results of certain experiments by Lorber are given, showing the conditions which may effect the accuracy of the instrument and the average amount of error which may be expected with instruments of typical form.

As a whole the book is clearly written and contains a large amount of matter which should be most useful and helpful to all who have occasion to use the planimeter in general office engineering work.

Commutator Construction. By William Baxter, Jr. Pamphlet form. Size 5 1-2 by 8 inches. Pp. 23, with 39 figures in the text. New York: The Derry, Collard Company. Price 25 cents.

Threads and Thread Cutting. By Colvin and Stabel. Pamphlet form. Size 5 1-2 by 8 inches. Pp. 32, with 28 figures in the text. New York: The Derry, Collard Company. Price 25 cents.

These pamphlets form numbers 3 and 4 of the series of practical papers published by this company. The purpose has been to provide a series of practical papers, each one having to deal with but one subject, and giving in clear and practical form the important points on this one subject.

The paper on commutators takes up in a clear way the design, construction, and maintenance of this feature of direct-current apparatus. No one item of such machinery is so fruitful of trouble as the commutator, and the clear explanation of the conditions to be fulfilled, the sources of the most common troubles, and their remedies should commend it to all who have to deal with this class of machinery.

The paper on screw threads explains in a clear and simple manner the nature of a screw, the standard forms and proportions of screw threads, the setting of the tool in the lathe, the cutting of the thread, with suggestions regarding the kink of catching the thread instead of waiting to run the carriage back over the length of a long thread. Double threads, cutting threads in the milling machine, chasing threads, and making the chasers are also discussed in the same clear manner. This paper should be of value to all who are interested in the special points connected with the cutting of screw threads.

The value of the paper would, however, have been improved by the addition of a section on the setting of the change gears of a lathe. It is possible that this topic is reserved for some future paper, but its connection with screw threads is so direct and vital that no more useful place for such a discussion could be found than in a paper on the cutting of screw threads.

SELECTED MARINE PATENTS.

747,393. SHIP-BUILDING. PETER EYERMANN, PHILADELPHIA, PA.

Claim.—1. A ship, the hull of which is constructed of metal tubes having external flanges, webs, fins or wings.

2. A ship, having ribs of metal tubes provided with external flanges, webs, fins or wings, and closed ends. Four claims.

747,349. KEEL-BLOCK. GUSTAVUS ANDERSON, CAMDEN, N. J.

2. Consisting of a ground or base section which gradually increases in height from its sides to its median plane, a similarly-formed, reversely-arranged, rider-section, two wedge-shaped pieces arranged between said base and rider sections, and means detachably connecting said intermediate pieces. Three claims.

747,506. OSCILLATING PROPELLER. WILLIAM B. TERRY, MARLOW, IND. TER. One claim.

747,654. PROPELLER. ROBERT W. SHAW, STAMFORD, CONN. One claim.

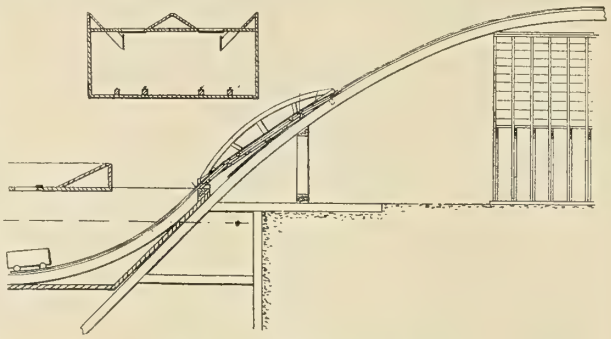
747,690. DISTANCE AND COURSE RECORDER FOR SHIPS. WILLIAM C. FORBES, ELSTERNWICK, VICTORIA, AUSTRALIA.

Claim.—1. In a distance and course recorder for ships, the combination with a meter, and a winding-drum connected therewith, of a chart, a carrier, a guideway therefor, and grips combined with the carrier to engage the chart.

2. In a distance and course recorder for ships, a compass-basin, a compass-card, an arm supported by the said card and bent around abaft and under the basin, a chart, and a recording implement carried by the arm and traversing the chart. Ten claims.

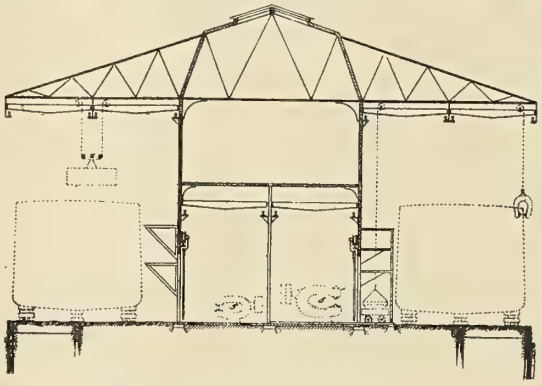
747,560. MEANS FOR DISCHARGING CARGOES. HORACE A. MIDDAUGH, SEATTLE, WASH.

Claim.—1. In an apparatus of the nature indicated; the combination of a barge having a railway-track, an upwardly-extending approach having a railway-track, a fender at the lower end of said approach, and a bridge comprising a span resting on said barge and against said approach and having a section of railway-track, and track-sections hinged to the extremities of said section on the bridge.



2. In an apparatus of the nature indicated; the combination of a barge having a hopper-shaped receptacle with gated openings in the bottom, and a railway-track beneath said openings, an upwardly-extending approach having a railway-track, a fender at the lower end of said approach, and a bridge comprising a span resting upon said barge against said approach and having a section of railway-track, and track-sections hinged to the extremities of said section on the bridge. Three claims.

747,782. SHIP-BUILDING PLANT. JOHN W. SEAVER, CLEVELAND, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE WELLMAN-SEAVER-MORGAN COMPANY, CLEVELAND, OHIO, A CORPORATION OF OHIO.



Claim.—1. A ship-building plant comprising an inclosed structure having walls and a roof provided with a series of roof-trusses, each of said trusses having an extended portion projecting beyond said inclosure, tracks supported by the projecting portions of the trusses and extending at right angles to the planes of said trusses, and a crane constructed to operate on said tracks.

2. The combination in a ship-building plant, of an inclosed structure having a series of trusses for supporting the roof thereof, each of said trusses having portions extending on both sides of the inclosed structure, tracks supported by the projecting portions of the truss, other tracks supported on the outside of the wall-supporting framework of the inclosed structure and cranes constructed to operate upon the tracks, said tracks extending at right angles to the planes of the trusses.

3. The combination in a ship-building plant, of an inclosed structure having walls and a roof, with a series of substantially parallel trusses for supporting said roof, said trusses having portions extending outside of the inclosed structure, three tracks supported from the under side of said extended portions of the trusses, one of the same being adjacent to the outer ends thereof and the others being carried at substantially the middle portions of said trusses, with a track supported on the outside of the wall-supporting framework of the inclosed structure, and cranes operative upon said tracks and movable in lines at right angles to the planes of the trusses. Three claims.

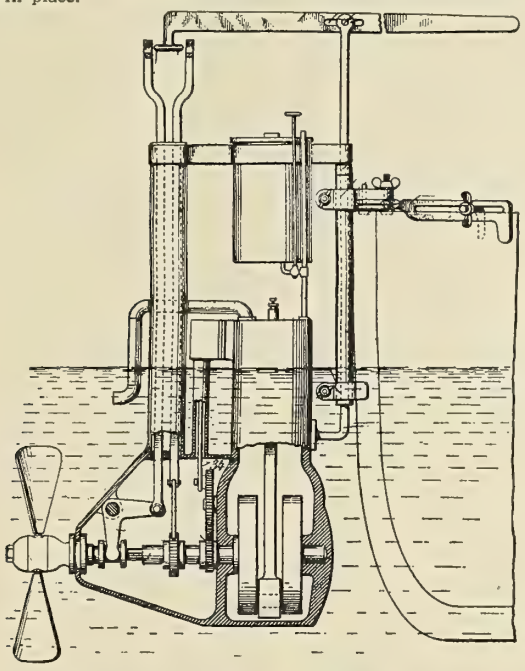
747,801. BOAT-PROPELLER. HARRY W. STURGES, WILTON, CONN.

Claim.—1. A boat-propelling device, comprising an internal-combustion motor, means for mounting the motor with a part of its cylinder submerged whereby to cool the cylinder, and a propeller in connection with the motor.

2. A boat-propelling device, comprising a clamping means, a tubular member fastened therein, a rod mounted to turn therein, a motor and propeller supported from the rod, and means in connection with the rod for turning the same to steer the boat.

3. The combination with a clamping device, of a tubular member carried thereby, a rod mounted to turn in the tubular member, a motor fastened to the lower end of the rod at an elevation sufficient to submerge the motor-cylinder, a propeller in connection with the motor, a fuel-tank carried from the upper portion of the rod, and means in connection with the rod, for turning the same to steer the boat.

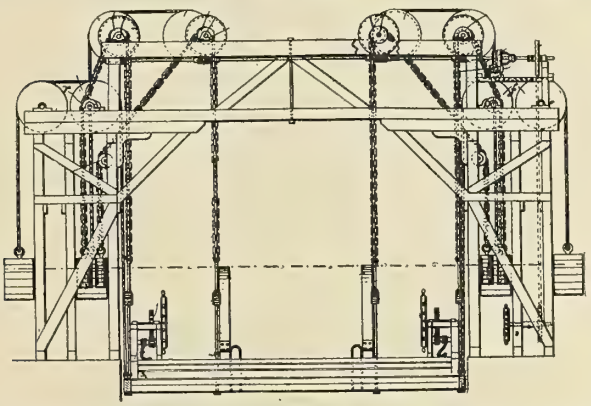
5. The combination of a motor, a propeller connected therewith, means for mounting the motor and propeller on the stern of a boat, outside thereof, and means for turning over the motor to facilitate starting the same, such means extending from a mobile part of the engine into proximity to the stern-sheets of the boat to permit operating them while the motor and propeller are in place.



6. The combination of a motor, a propeller, means for removably attaching the same to a boat, and reversing devices for the propeller-blades, said reversing devices extending from the propeller-shaft to permit reversing the propeller-blades while the motor and propeller are in place.

7. The combination of a motor, a propeller, means for mounting the motor and propeller on a boat, means for starting the motor, means for reversing the propeller-blades, and a tiller connected with the motor to turn the same to steer the boat and movable into engagement with either the means for starting the engine or for reversing the propeller-blades. Nine claims.

747,836. FERRY-BRIDGE. JOHN ANDERSON, NEW YORK, N. Y.



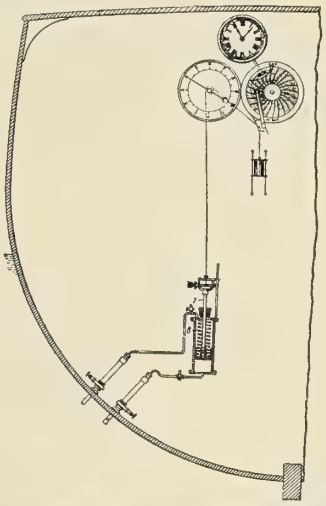
Claim.—1. The combination with a ferry-bridge, or counterbalancing means for taking up the main weight of the bridge, worm-gear mechanism, operating means therefor, and a flexible connection under constant stress between the gear and the bridge and independent of the counterbalancing means, for raising and lowering the bridge and taking strains off the gear. Five claims.

748,176. SCREW-PROPELLER. THOMAS H. EASTWOOD, McMINNVILLE, TENN. One claim.

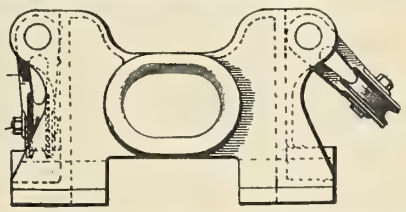
748,159. DEVICE FOR RECORDING SPEED OF VESSELS. JEFFERSON S. BRIGGS, BROOKLYN, N. Y.

Claim.—1. In a device for recording speed of vessels, a cylinder, a piston located in said cylinder, a scoop, a static pressure-tube and means for admitting water-pressure from the two scoop and tube respectively to opposite sides of the piston.

3. In a device for recording speed of vessels, a cylinder, a piston located in said cylinder, a tension device, a connection between the tension device and the piston, means whereby said connection operates an indicator, a scoop having a connection admitting pressure to one surface of said piston and a static tube admitting pressure to the opposite side of said piston. Three claims.



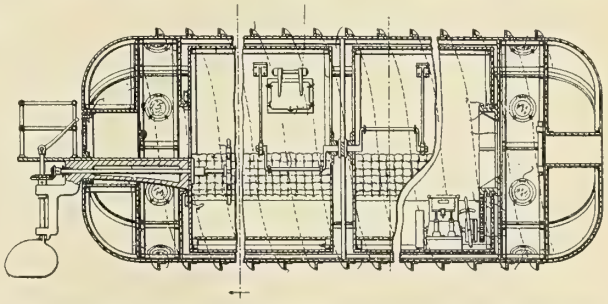
748,618. DEVICE FOR MOORING AND WARPING VESSELS. JOSEPH KIDD, DULUTH, MINN.



Claim.—1. In a mooring and warping device, the combination of a body portion, a sheave-supporting shell pivoted thereon, a sheave therein, the said shell having a mortise larger than the sheave with an enlarged opening 16 above the mortise, separated therefrom by a slot 17 adjacent to the sheave-score, the said slot being narrower than the width of the sheave. One claim.

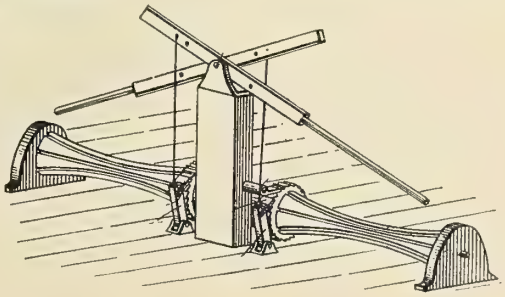
748,757. WAVE-MOTOR. JOHN A. LANGSTROTH, OAKLAND, CAL. One claim.

748,919. LIFE-BOAT. ROBERT A. BROWN, CHICAGO, ILL.



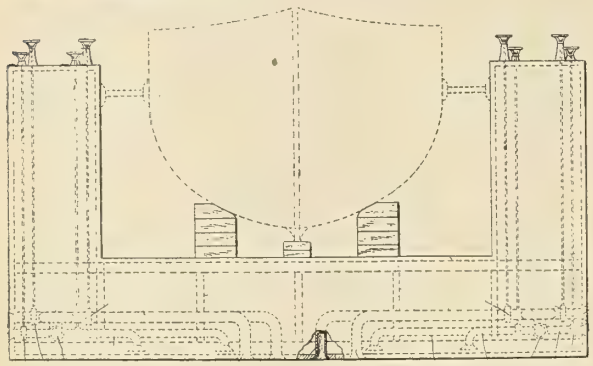
Claim.—1. In a boat of the class described, the combination of a horizontally-disposed hull of substantially circular transverse cross-section, comprising a shell of sheet metal, a plurality of longitudinally-disposed stiffening-bars secured to the inner surface of said shell, and a transversely-disposed stiffening-bar extending spirally around the outer surface of said shell, said outer stiffening-bar having an outwardly-projecting flange; a car journaled concentrically within said hull; and means for rotating said hull about said car and propelling same, through the action of said outer flange. Two claims.

749,188. SHIP'S WINDLASS. JOHN HANSEN, NORTH-COVE, WASH.



Claim.—1. In a windlass, the combination with the central standard, of the winding-drums and operating-pawls, an operating lever composed of two independent members pivoted on the same pin and adapted to be operated independently, means for connecting said members together to form a single lever, and connecting means between said members and the said operating-pawls. One claim.

749,171. FLOATING DOCK. ANDREW C. CUNNINGHAM, WASHINGTON, D. C.



Claim.—1. In a floating dock having the usual arrangement of pipes for filling and emptying the dock, the combination with the main pipe having branches leading to the several compartments, of a pump connected to said pipe to take water therefrom, and a pipe connected to the pump to receive water from the pump, said pipe opening through the bottom of the dock to discharge the water forcibly under it. Two claims.

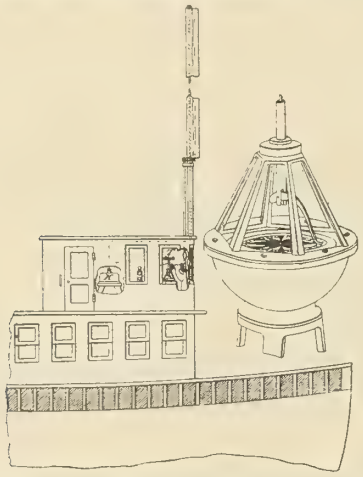
749,412. BOAT. ALBERT VIERT, CHICAGO, ILL.

Claim.—1. A hull for vessels or ships provided at its prow portion with a downwardly and rearwardly extending fin, said fin being thicker at its middle portion than at its ends. One claim.

749,427. HYDRAULIC PROPELLER FOR VESSELS. JOB DUDLEY, HAMILTON, CANADA. One claim.

748,453. PROPELLING DEVICE FOR BOATS. JAMES S. WORCESTER, NEWARK, N. J. Five claims.

749,694. MEANS FOR DETERMINING THE NAUTICAL BEARING OF NAVIGABLE VESSELS. HERMON W. LADD, BOSTON, MASS., ASSIGNOR TO GEORGE E. SMITH, TRUSTEE, EVERETT, MASS.



Claim.—1. Means for receiving Hertzian-wave signals and messages, comprising a wave-catching conductor, in combination with a shield open on one side to expose said conductor to the transmitted waves in certain directions, and closed on its other sides to shield the conductor therefrom in other directions, for the purpose set forth. One claim.

749,754. ALTISCOPE FOR SUBMARINE BOATS. LAWRENCE Y. SPEAR, GREENPORT, N. Y., ASSIGNOR TO ELECTRIC BOAT COMPANY, A CORPORATION OF NEW JERSEY.

Claim.—1. An altiscope for submarine and other boats, comprising a group of upright, altiscope optical tubes connected with the turret or conning-tower of the boat, said tubes having their image-receiving mirrors faced outwardly in different directions and having their observing-telescopes within the turret directed radially inward. One claim.

749,860. MEANS FOR LOADING OR UNLOADING VESSELS. HENRY M. HARDING, NEW YORK, N. Y. One claim.

749,909. SHEATHING FOR VESSELS. RICHARD D. UPHAM, NEW YORK, N. Y.

Claim.—1. A sheathing for vessels and the like, comprising a backing of flexible and tough sheet material, and a flexible facing compound on said backing and attached thereto, said compound consisting of a suitable insulating substance, and comminuted metal, intimately mixed and compressed. One claim.

749,920. PILE-PROTECTOR. AUGUSTUS S. COOPER, OAKLAND, CAL.

Claim.—1. A pile-protector comprising a floating substance noxious to pile-destroying worms, bugs and insects, and a dam to confine said floating substance about the pile. One claim.

747,923. APPARATUS FOR LOADING OR UNLOADING VESSELS. GEORGE H. AIREY, PARIS, FRANCE.

Claim.—In means for loading and unloading vessels wherein the goods are run down an inclined rope from the delivering to the receiving vessel, an endless-band elevator; lifting-arms outstanding from the said endless band; an inclined tube at the top of the elevator-mast through which passes the inclined rope; lifting-hooks to hang on the said lifting-arms on the endless band, the said hooks having a flat overturned part to rest on the lifting-arms and an upstanding loop above the said flat overturned part and a downturned and outwardly-sloped arm by which the hook and its load are shunted from the lifting-arm on to the inclined tube and from thence to the inclined rope. One claim.

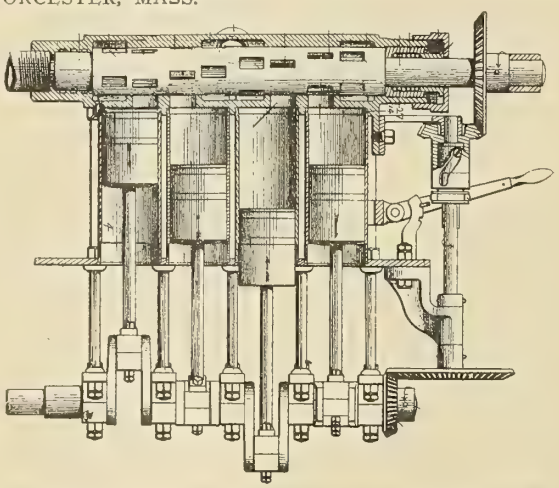
749,927. DISTANCE-RECORDER FOR SHIPS. WILLIAM C. FORBES, ELSTERNWICK, VICTORIA, AUSTRALIA.

Claim.—1. In a distance-indicator for ships, a pipe having an inlet and an outlet branch projecting through the ship's bottom, a valve in each of the branches, a worm-wheel on the stem of each of the valves, and a worm meshing with the worm-wheel and provided with an operating-spindle. One claim.

749,957. PILE-STRENGTHENER. AUGUSTUS C. COOPER, OAKLAND, CAL.

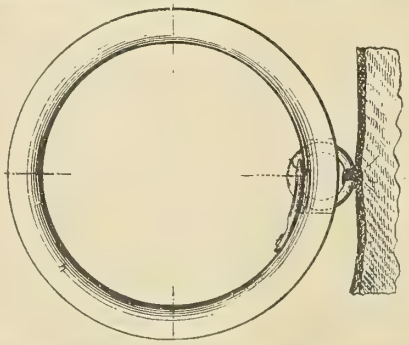
Claim.—1. A pile-strengthener comprising a plurality of braces disposed to bridge the weakened portion of the pile and to bear with their ends against the upper and lower ends of said portion, and means for tying said braces together to hold them against the pile. Two claims.

749,958. STEAM-ENGINE. CHARLES CROMPTON, WORCESTER, MASS.



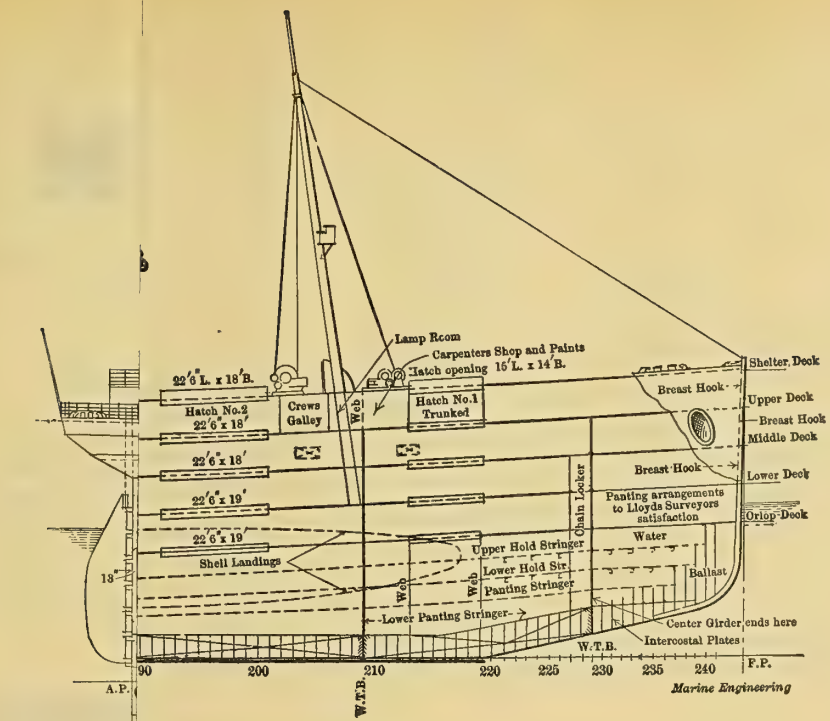
Claim.—1. In an engine, the combination of a hollow bar forming a steam-chest and having a series of sockets to receive the cylinders, a series of cylinders held in said sockets, said bar having a series of steam-spaces communicating with said cylinders and a valve contained in said hollow bar, whereby the flow of steam to said cylinders is controlled. One claim.

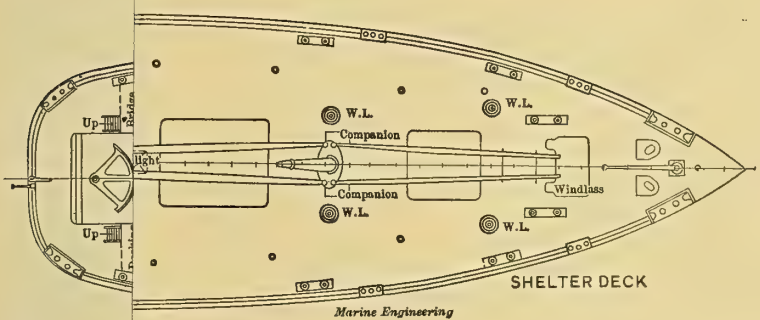
749,968. DETACHABLE SAIL-FASTENING FOR MAST-HOOPS. ALBERT KLATT, COLLINSVILLE, CAL., ASSIGNOR OF ONE-HALF TO EMIL EMMINGTON, COLINSVILLE, CAL.

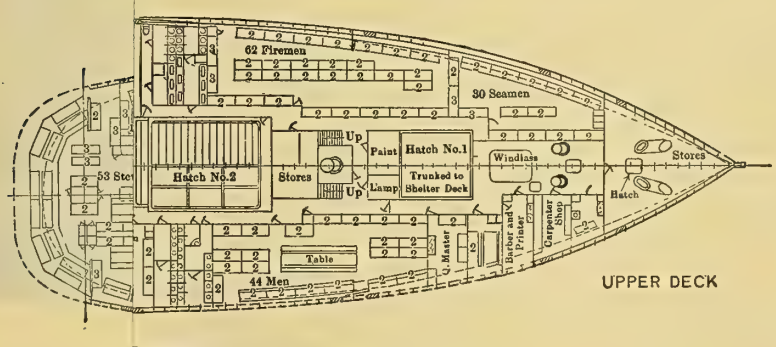


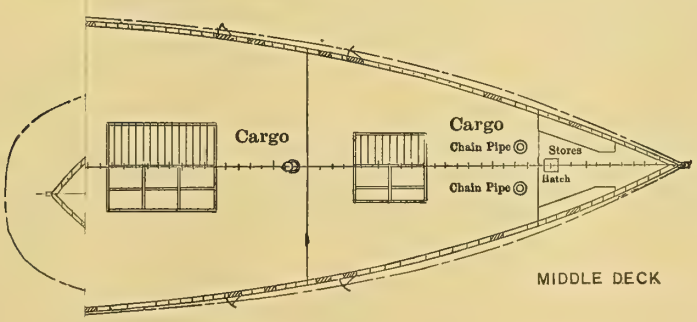
Claim.—1. A device for securing sails to mast-hoops, comprising a ring secured to the sail, a mast-hoop having an aperture to admit the ring, and a latch insertible through the ring between the hoop and the ring after the latter is passed through the aperture in the hoop. One claim.

750,036. SCREW-PROPELLER. ERNST A. NILSEN, CHRISTIANIA, NORWAY.









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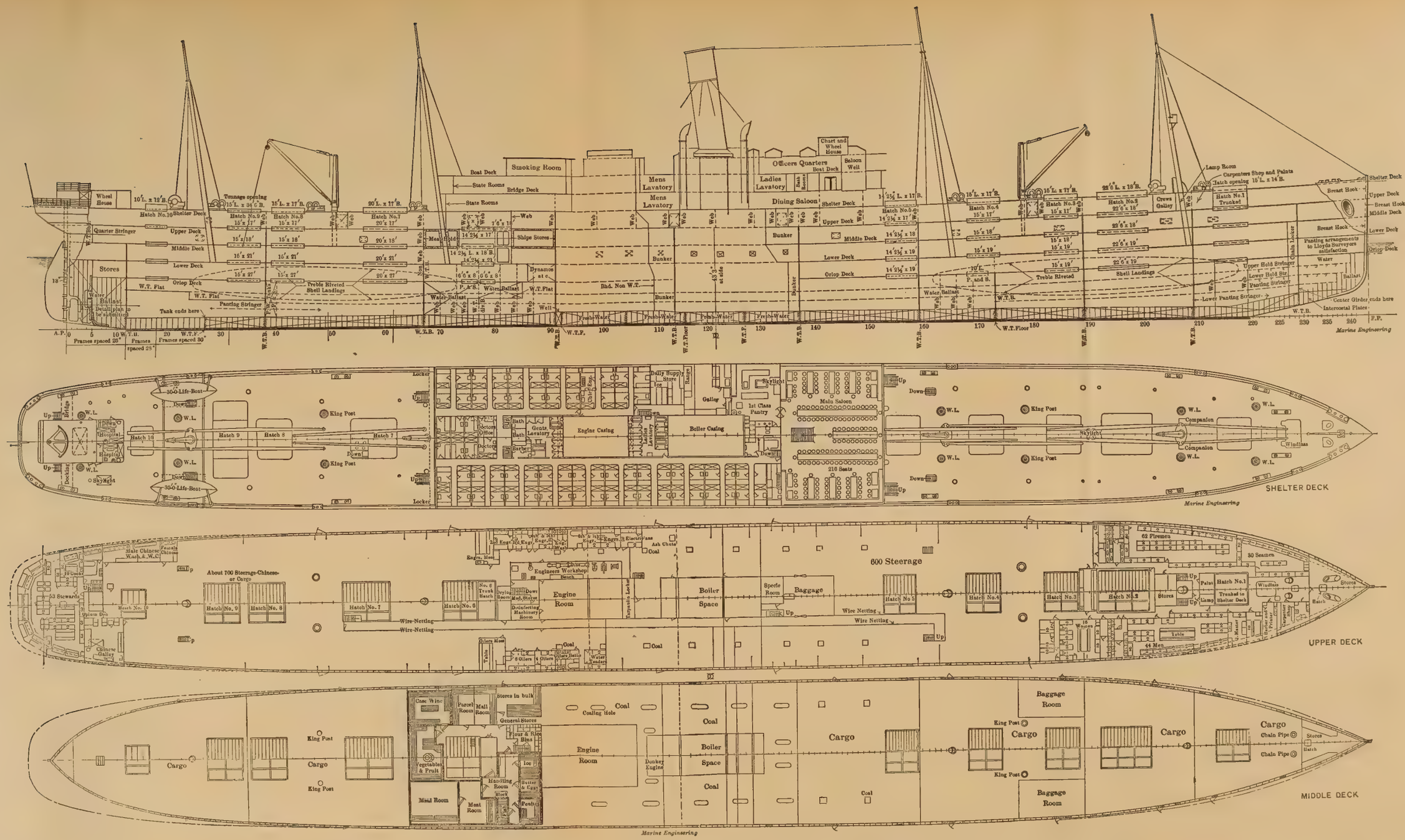

INBOARD PROFILE AND DECK PLANS OF THE NEW 600-FOOT TRANSPACIFIC TWIN SCREW STEAMSHIPS MONGOLIA AND MANCHURIA, BUILT BY THE NEW YORK SHIPBUILDING COMPANY FOR THE PACIFIC MAIL STEAMSHIP COMPANY.

Marine Engineering

Vol. IX. NEW YORK, APRIL, 1904. No. 4.

NEW STEAMSHIP MONGOLIA, FOR THE PACIFIC MAIL STEAMSHIP COMPANY.

The New York Shipbuilding Company, Camden, N. J., has just delivered to the Pacific Mail Steamship Company the latest product of American shipbuilding in the twin screw steamer *Mongolia*. This vessel left Norfolk, Va., on the 20th of February for San Francisco and will run between San Francisco and Japanese and Chinese ports. As in 1902, the Pacific Mail Steamship Company brought out the two largest vessels then built in the United States, viz: the *Korea* and the *Siberia*,* so to-day they still hold this record with the *Mongolia* and her sister ship, the *Manchuria*, which is fitting out at Camden, and which will be delivered shortly.

NEW PACIFIC MAIL TWIN SCREW STEAMSHIP MONGOLIA.

The principal dimensions are given below and further data will be found in the card on page 160.

Length	615 ft. 8 in.
Breadth	65 ft. 0 in.
Depth to shelter deck	51 ft. 3 in.
Load draft	33 ft. 6 in.
Registered gross tonnage	13,639 tons.

The latest experience has been used in making these vessels the most efficient of their class and the safest for the transport of passengers and cargo. A strict inspection has been given them as is shown by the fact that the American Bureau of Shipping has given them the highest rating and the Lloyd's Register of British and Foreign Shipping has classed them 100-A1, Special Survey; the Bureau Veritas has accorded them the highest class and they conform to all the requirements of the Board of Supervising Inspectors of steam vessels of the United States, and the British Board of Trade.

HULL CONSTRUCTION.

The structural material is steel and has been tested to the requirements of the classification societies, and the scantlings are also in accordance with their rules.

The keel is of the flat plate type, with a horizontal bar keel fitted, 3 inches thick. The center keelson is continuous all fore and aft. The stern frame is of cast steel, in two pieces, and is arranged with an aperture between the propellers. The shaft brackets are of cast steel and of the spectacle type with the shell plating carried right

* For complete description and plans see MARINE ENGINEERING, May, 1902.

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aft and riveted to the brackets. The rudder is of the single plate type, the stock being of wrought steel, the rudder frame and arms of cast steel in one piece and coupled to the stock. The stem is in two pieces, the lower portion being of cast steel and the upper a forging.

The double bottom extends all fore and aft and has solid floors on every frame with three longitudinals on each side between the center keelson and the margin plate. Extra keelsons are fitted at the fore end and under the engine. The capacity of the double bottom is 2,270 tons of water and is arranged so that fresh water can be carried for the use of the boilers or the ship The peaks are fitted as trimming tanks. Besides the water ballast in the double bottom there are three deep tanks, one fitted forward and two abaft the engine room. There is a total weight of water ballast of 4,600 tons.

Special consideration has been given to the riveting of the shell plating. The spacing of the rivets has been increased in certain parts. The rivets are all machine riveted, the sheer strake and two strakes below having button points for more than half the length of the vessel. Special compensation is fitted in the way of the cargo ports, coal ports and sidelights.

The *Mongolia* has five complete decks: orlop, lower, middle, upper and shelter; over the accommodation amidships are the bridge and boat decks. In earlier vessels of this type, the strength deck was at the upper deck, but in the *Mongolia* it was raised to the shelter deck and the ends of the superstructure have been strengthened so as to overcome the weakness shown in earlier vessels. There are 10 water-tight bulkheads which run up to the upper deck. A non-water-tight center line bulkhead is fitted from the top of the inner bottom to the orlop deck; this greatly adds to the strength and serves as a shifting board when carrying grain cargoes.

The coal bunkers are arranged at each end of the boiler space and contain a permanent supply of 1,950 tons, with a reserve bunker at the fore end capable of increasing this amount by 2,800 tons. Coaling hatches are conveniently arranged on the upper deck, and side ports are also fitted on the sides of the vessel for loading coal from barges.

PASSENGER ACCOMMODATIONS.

The first-class passenger accommodation is in the midship house on the shelter and bridge decks.

SHELTER DECK.

On the shelter deck at the fore end is the dining saloon which has seats for 216 and extends from side to side of the vessel. The sides and ends are finished in dark oak with a dull finish, the panels between beams are staff, and the coloring of the ceiling is white and gold. The type of sidelights at the fore end is a combination port and rectangular ventilator which can be opened from the inner side; on the sides of the saloon circular ports are fitted. All these sidelights have Venetian sliding shutters. There is a light well over the center of the saloon which is lighted through a skylight over the music room above. At the after end of the dining saloon is the grand stairway which leads up to the social hall on the bridge deck.

Immediately abaft the dining saloon on the starboard side of the shelter deck is the purser's office fitted up with desk, safe, etc., and on the opposite side of the starboard passageway is the steward's office and a stairway leading down to the baggage-room.

From the purser's office right aft on the starboard side, across the after end of the deck-house end extending on the port side as far forward as the engine casing, the first-class staterooms are arranged. These rooms are fitted up with four beds, two of them being Hoskins, and the sofa and sofa back forming the other two. Beautiful mahogany fold-up lavatories and electroplated fittings are supplied to all these rooms, with red curtains to sidelights, beds and doors. The inner rooms are well ventilated through rectangular trunk ventilator fitted to the deck-house coaming on the bridge deck.

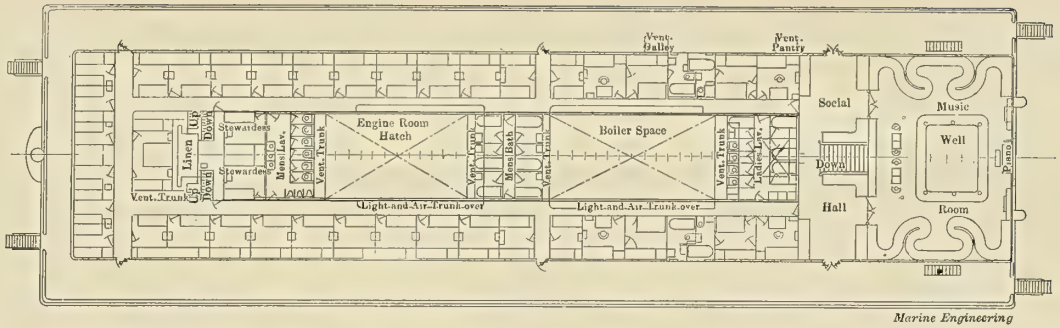
Between the engine and boiler casing and immediately abaft of the engine casing are located the ladies' and men's lavatories, fitted up with wash basins, pier glasses, etc., well ventilated and having the floor mosaic tiled. The doctor's room, dispensary and barber shop are conveniently situated on this deck.

Abreast of the engine casing on the port side are rooms for the chief engineer, first assistant engineer, chief steward, second steward, storekeeper and freight clerks, and immediately on the fore side of these rooms are the daily supply store, butcher shop, galley and pantry, the latter opening into the dining saloon. The butcher shop and daily supply store are fitted up with all the necessary chopping blocks, shelves and bread bins, and each has an ice-box. In one corner of the main galley is a bakery. The first class pantry is spacious and fitted up with hot press, dish wagon and all the necessary silver lockers and racks An elevator is used for serving to the officers' pantry and for light refreshments on the boat deck.

BRIDGE DECK.

The grand stairway in the main saloon leads to the social hall or entrance on the bridge deck, the panelling of which is the same as the saloon, dark oak with a dull finish. A skylight with decorated leaded glass gives light and ventilation to the stairway and social hall. On the forward side of the social hall is the music room, which is finished in white and gold and tapestried furnishings. A large skylight with decorated leaded glass surmounts the well in the center of the music room. A piano is placed in the fore side, sidelights have cathedral glass in sliding windows.

Two suites of rooms on each side are arranged immediately abaft the social hall, which consist of sitting-room, bed-room and bath-room. The sitting-room is furnished with writing table, folding lavatory, wardrobe, and the bed-room has a large brass bedstead, sofa and wardrobe. The furniture is of dark mahogany, and the paneling of sides and ceiling is painted white. Large staterooms for three persons, similarly fitted up to the staterooms on the shelter deck, are arranged around the bridge deck-house. The lavatories and baths are located in the center of the deck-house, and like the sanitary accommodation of the shelter deck, have fine ventilation. There is a good promenade on each side of this bridge deck with the boat deck as a shelter.



BRIDGE DECK OF THE MONGOLIA. FOR OTHER DECK PLANS SEE THE INSET.

BOAT DECK.

On the boat deck, at the fore side of the boiler casing, is a large deck-house containing the captain and officers' quarters. The captain's bedroom is furnished in mahogany and opens into a large day room which is paneled in white and furnished with a large mahogany roll top desk, table and chairs. The officers' mess room is on the starboard side and conveniently located to the pantry, which is supplied by an elevator from the main galley.

Abaft the engine casing is the smoking-room and bar, which is paneled in Flemish oak, and with a frieze of paneling at the top depicting Dutch water scenes. Sliding shutters are fitted with leaded glass depicting drinking scenes, comfortable leather-covered settees, card tables and revolving chairs are provided.

Two stairways on the after end lead to the bridge deck. The lifeboats are arranged to stow on deck and to hang overboard at sea, thus enabling the passengers to use the sides of this deck for a promenade.

Above the officers' quarters is a house containing the wheel and chart room; an extension of the roof of this wheel house give protection to the steering wheel, telegraphs and compass.

UPPER DECK.

On the upper deck forward on the port side are rooms for the seamen, firemen and their sanitary quarters. On the starboard side are the rooms for quartermasters and petty officers, together with rooms for steerage passengers. On this deck on each side of the engine casing are rooms for the engineers, electricians, oilers and water tender, and at the after end are located the stewards and cooks. The remainder of this deck can be used for light cargo or steerage, and in the event of Chinese steerage being carried, a Chinese galley and wash places have been fitted at the stern.

On the upper deck abaft of the engine room a very large refrigerating space has been arranged convenient to the galley, and divided up with rooms for butter and eggs, poultry and game, wine, vegetables and fruit and meat.

The vessel has four masts, with fore-and-aft sails, and is fitted with derricks on all these masts for the rapid handling of freight.

MAIN ENGINES.

The vessel is twin screw with engines of 10,000 I.H.P. The engine room is very spacious, extending the entire width of the ship, and 45 feet 6 inches fore and aft. All this area is available with the exception of the small corner spaces occupied by the engine room wing bunkers. The absence of a midship bulkhead between the engines still further adds to the appearance and spaciousness of the engine room. The height from the engine-room floor plates to the skylights is 70 feet.

The engines are four-cylinder, quadruple expansion of the usual marine type, with Stephenson link valve motion. The diameter of the cylinders are 30, 43, 63 and 89 inches, with a common stroke of 5 feet. The designed pressure at the engines is 200 pounds. The propellers turn outboard. The cylinders are arranged from forward aft, as follows: High pressure, second intermediate, low and first intermediate. The length between centers is 8 feet 5 inches, 14 feet 3 inches and 8 feet 5 inches respectively.

The cylinders are supported on eight cast iron housings of box-section. The two forward back housings and the four front housings run clear from the cylinder feet to bed plate; the two after back housings run to the top of condenser, which extends only half the length of engines from the after end. The cylinders are free to expand independently of each other, each one

being bolted only to its own housings, while the housings are joined at their upper ends by horizontal cast iron girders of box section. This construction has been adopted by the New York Shipbuilding Company for its engines, as it gives a very secure connection, while at the same time it allows independent expansion of the cylinders. The overhang of the L.P. valve chest is carried on shoes which are free to move on the horizontal girders.

The bed-plate is of cast iron, in four parts, of box section throughout, with lightening holes reinforced. The columns are fitted with handhole plates and utilized as oil tanks.

The main valves are of the piston type, with the

TABLE OF EQUIPMENT AND SCANTLINGS OF THE MONGOLIA AND MANCHURIA.

EQUIPMENT.

3 Bower anchors, stockless, of 119 1-4 cwt. each.
1 Stream anchor, stockless, of 48 3-4 cwt.
1 Kedge anchor, stockless, of 26 1-4 cwt.
Stud chain cable, 330 fathoms 3 2-16.
Stream cable, 150 fathoms 6 1-2 in. steel wire.
Tow line, 140 fathoms 7 1-2 in. steel wire.
Hawsers, three 120 fathoms each, 8 in. Manilla.
Wards, three 120 fathoms each, 8 in. Manilla.

SCANTLINGS.

Frames: Spaced 30″ except in peaks where they are spaced 26″ and for 6 spaces inboard which are spaced 28″, 9″ x 4″ x 4″ x 13-20″ channel for 3-5ths L., 9″ x 3.9″ x 3.9″ x 11-20″ bet. 3-5th L., and 3-4ths L. and 9″ x 3.85″ x 3.85″ x 10-20″ at ends. In peaks 6″ x 4″ x 12-20″ angle. In double bottom 4″ x 4″ x 11-20″ doubled from 3-5ths L. ford. to collision bulkhead. 4″ x 4″ x 12-20″ under boilers.

Bulkhead frames double 5″ x 4″ x $\frac{13\text{-}12''}{20}$ to shell

Bulkhead angles to tank top 4″ x 4″ x $\frac{10\text{-}9''}{20}$ and to all decks 3 1-2″ x 3 1-2″ x 10-20″.

All frames to extend to shelter deck.

Frames from No. 19 to No. 28, inclusive, to be 6 1-2″ x 4″ x 11-20″ angle.

Bossed angles from No. 13 to No. 18 inclusive to be 6 1-2″ x 4″ x 11-20″ angle.

Frames from margin plate to orlop deck doubled in Nos. 1 and 2 holds, with 6″ x 4″ x 11-20″ angles on every frame in No. 1 and every alternate in No. 2.

In engine space every alt. frame (9″ x 4″ x 4″ x 13-20″ channel) to be doubled from margin plate to middle deck stringer. In boiler space every frame will be thus doubled.

Reverse Frames: In peaks 6″ x 4″ x 11-20″ to extend alternately to shelter and upper decks. In holds 4″ x 4″ x 12-20″. On alternate frames to lower edge of orlop deck beam knee. In double bottom 3 1-2″ x 3 1-2″ x 10-20″, at W. T. floors 4″ x 4″ x 11-20″. Under engine and boiler space 3 1-2″ x 3 1-2″ x 11-20″ doubled. From No. 19 to No. 28, inclusive, to be 6″ x 4″ x 11-20″ angle.

Bulkheads: Plating 8-20″ to 7-20″.

Bulkhead web stiffeners 15″ x 3.426″ x 3.426″ x 35 lbs.

Shaft Tunnel: 8-20″ plating and 5″ x 4″ x 11-20″ angle stiffeners, spaced 4′ c. to c. under hatches. Stiffeners are spaced 3′ c. to c. additional stiffeners are to be fitted where pillars heel on tunnel top.

Stem: 12″ x 4″ W. I. Lower part of cast steel.

Stern Post: 13″ x 6″ cast steel.

Rudder Head: 15 1-4″ dia. Pintles 7 5-8″.

DECK PLATING.

Bridge Deck: 5-20″ double riveted butt laps, landing single riveted 5-8″ rivets. Stringer: triple riveted butt laps, 3-4 rivets.

Shelter Deck: 8-20″ at ends double riveted butt laps for 1-2 L. Double riveted at ends. Landings single riveted. Rivets 7-8″ and 3-4″ dia. Plating between hatches 10-20″. Stringer: Triple riveted double butt straps 13 11-20″ for 1-2 L., triple riveted single straps at ends, 2-20″ thicker than plates Doubling plate, triple riveted double butt straps for 1-2 L. 12 10-20″ triple riveted. Single straps at ends of 1″ rivets.

Upper Deck: 11-20″ for 1-2 L. 8-20″ at ends. Treble riveted butt laps for 1-2 L. Double riveted at ends. Landings single riveted. 7-8″ rivets amidships, 3-4″ at ends. Plating between hatches 8-20″. Stringer: triple riveted double butt straps for 1-2 L., triple riveted single straps at ends, single straps 2-20″ thicker than plates. 1 1-2″ rivets amidships, 1″ rivets at ends.

Middle Deck: 9-20″ for 1-2 L. 8-20″ at ends. Double riveted lap butts for 1-2 L. Single riveted lap butts at ends. Landings single riveted. 3-4″ rivets. Plating between hatches 8-20″. Stringer: triple riveted lap butts for 1-2 L, double riveted lap butts at ends. 1″ rivets amidships, 7-8″ at ends.

Lower Deck: 8-20″ for 1-2 L., 7-20″ at ends. Double riveted lap butts for 1-2 L. Single riveted lap butts at ends. Landings single riveted. 3-4″ rivets. Stringer: triple riveted lap butts for 1-2 L., double riveted lap butts at ends, 7-8″ rivets.

Orlop Deck: 7-20″ throughout. Double riveted lap butts for 1-2 L. Single riveted lap butts at ends. Landings single riveted. 3-4″ rivets. Stringer same as lower deck.

Bar Keel: 1 1-4″ rivets spaced 5 diams. center, butts to be scarfed 28″ long.

Keel: Treble riveted double butt straps all F. & A. butt straps both 15-20″ amidships, 13 11-20″ at ends, 1 1-8″ rivets amidships, 1″ rivets at ends.

SHELL PLATING.

A: Quadruple riveted lap butts for 1-2 L., treble riveted butts at ends. 1 1-8 and 1″ rivets

B, C, D and E: Quadruple riveted lap butts for 1-2 L., treble riveted lap butts at ends. Where outside strakes are less than 46″ and inside strakes are less than 54″, 1″ rivets.

F: Quadruple riveted lap butts for 1-2 L., treble riveted at ends, if under 46″ wide, 1″ rivets.

G: Quadruple riveted lap butts for 1-2 L., treble riveted at ends, if under 54″ wide, 1″ rivets.

H: Quadruple riveted lap butts, 1″ rivets

J: Quadruple riveted lap butts for 1-2 L., treble riveted at ends, if under 54″ wide, 1″ rivets.

K: Quadruple riveted lap butts for 1-2 L., treble riveted at ends, if under 54″ wide, 1″ rivets.

M: Quadruple riveted lap butts, 1″ rivets.

N: Quadruple riveted lap butts for 1-2 L., treble riveted at ends, if under 54″ wide, 1″ rivets.

O: Quadruple riveted lap butts 1″ rivets.

P. Quadruple riveted lap butts for 1-2 L., treble riveted at ends, if under 54″ wide, 1″ rivets.

R: Quadruple riveted lap butts, 1″ rivets.

S: Quadruple riveted lap butts for 1-2 L., treble riveted at ends, if under 54″ wide, 1″ rivets.

T: Quadruple riveted lap butts throughout

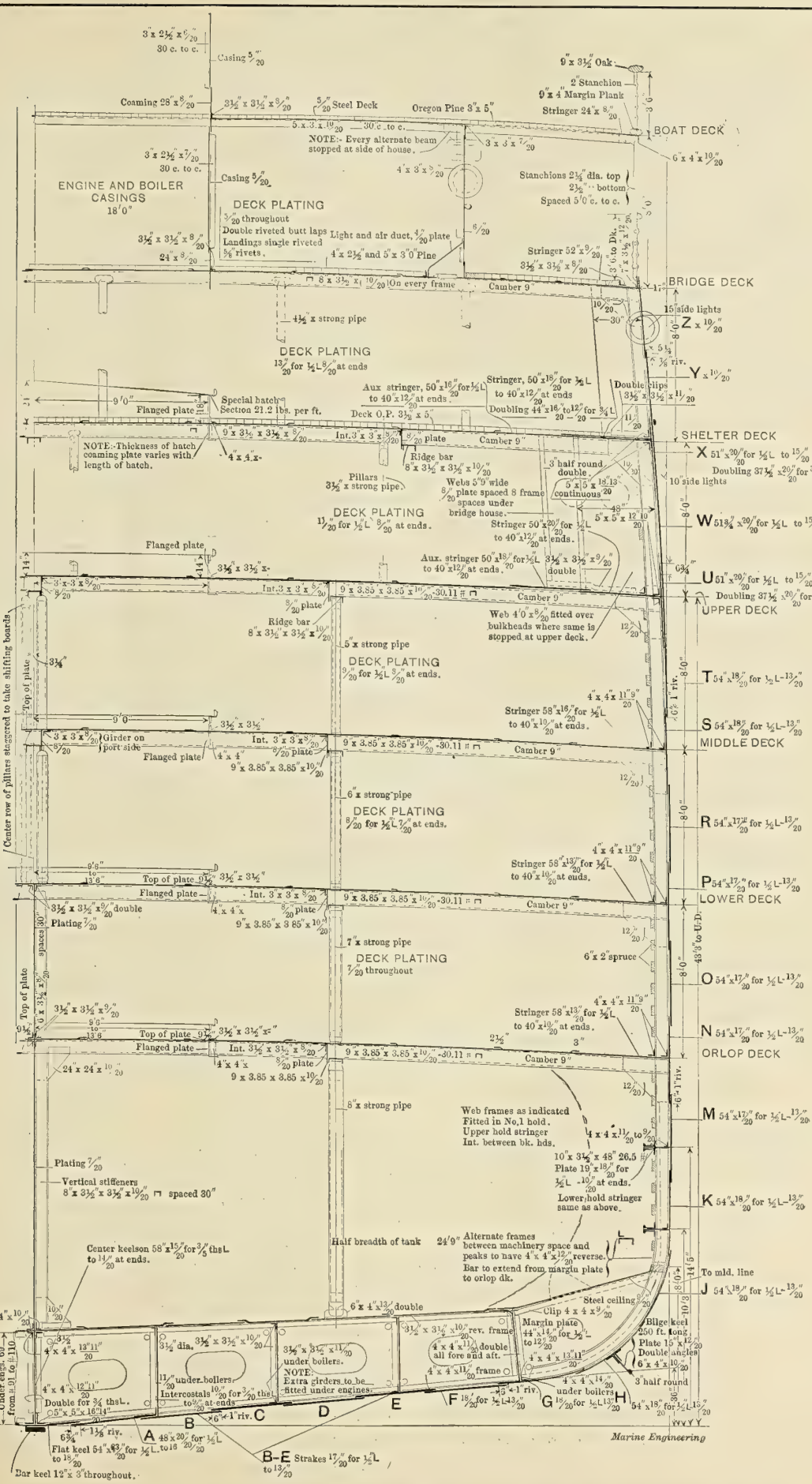
U: Treble riveted double butt straps $\frac{14\ \&\ 13''}{20}$ for 3-4 L. and treble riveted single butt straps, outside 2-20″ thicker than plates at ends. Rivets 1 1-8″ amidships, 1″ at ends, doubling 37 1-2 by 20-20″ for 3-5th L. Treble riveted double butt straps.

W: Treble riveted double butt straps $\frac{14\ \&\ 13''}{20}$ for 3-4 L. and treble riveted outside. Single butt straps (2-20″ thicker than plates) at ends, 1 1-8″ rivets amidships, 1″ rivets at ends.

X: Treble riveted double butt straps for 3-4 L. and treble riveted single outside butt straps at ends, straps $\frac{14\ \&\ 13''}{20}$ for 3-4 L. Straps at ends 2-20″ thicker than plates, doubling 37 1-2″ by 20-20″ for 3-5 L., with treble riveted double butt straps, 1 1-8″ rivets amidships, 1″ rivets at ends.

Y: Treble riveted butt laps fore and aft, 7-8″ rivets.

Z: Treble riveted butt laps fore and aft, 7-8″ rivets.



MIDSHIP SECTION OF TWIN SCREW STEAMSHIPS MONGOLIA BUILT BY THE NEW YORK SHIPBUILDING COMPANY.

exception of the L. P., which is double ported slide. A piston valve of 16 5-8 inches diameter supplies the H.P., one of 22 inches supplies the 1st I. P. cylinder, while the 2d I. P. has two of 21 inches diameter, driven from a cast steel crosshead. The L. P. and 2d I. P. valve gears are balanced with the Lovekin-Thom assistant cylinder. These cylinders are located over the valve stems which have extensions for pistons as in ordinary balance cylinder. The 2d I. P. assistant cylinders take their steam from the L. P. receiver through a sleeve on the stem. The L. P. assistant cylinder takes its steam from the 1st I. P. receiver, reduced down to 85 pounds. This allows a small assistant cylinder to be used for the heavy gear. The smooth working of these heavy valve gears under normal conditions shows them to be relieved of all strains due to inertia and gravity. By throttling down the supply to the L. P. assistant cylinder it was observed that the consumption of steam was practically nothing. This accords with the theory of their design, there being no exhaust, as the desired balance is obtained simply by alternate compression and expansion arranged to suit the forces expected. The only consumption of steam is that due to losses by radiation and leakage.

The main pistons are conical. The H. P., 1st I. P., and L. P. are cast steel, and the 2d I. P. cast iron. Lockwood and Carlisle packing rings are used in the L. P. piston and others have three spring rings of the usual type. The follower bolts screw into composition plugs in the piston bodies. Metallic packing is used on the H. P. and 1st I. P. rods and valve stems; fibrous in all others.

The piston rods are of mild open-hearth forged steel, 9 inches diameter. The 2d I. P. and L. P. rods carry extension tail rods of 6 3-4 inches diameter. The crossheads are of same material as piston rods and secured by tapered fit. The crosshead shoes are cast iron, adjustable, lined with white metal. The connecting rods are also of mild steel, 11 feet 3 inches between centers, with fork end tops provided with phosphor bronze boxes.

The crank shafts are of the built-up type, mild steel, 18 inches diameter, with a 4-inch bored hole. The thrust, line and tail shafts are of the same material, 17 3-4 inches, 17 1-8 inches and 18 1-4 inches diameter, respectively, with 6-inch bored hole. The thrust shaft has 8 collars, 28 1-4 inches diameter, running between adjustable horseshoe bearings of the usual type. Around the flange on forward end of tail shafts a cast iron ring is fitted, and just aft of this, but clear of it, is a stop secured to the framing of the shaft boss. The purpose of this gear is to prevent the tail shaft working aft should breakage occur in the line shaft. Efficient trolley gear provides a means for quickly withdrawing tail shaft for examination, etc. The stern tubes are of cast iron in two sections. The nuts on the stern gland are worked by rack-gearing from a worm wheel and pinion.

The propellers are three-blade, built up with manganese bronze blades and cast iron hubs, arranged to allow adjustment of pitch from 21 feet 8 inches to 25 feet 4 inches. The diameter of tips of blades is 18 feet 6 inches.

The condensers are of cast iron, built in abreast of the two after cylinders. The tube-cooling surface of each is 7,500 square feet. The circulating water enters at the top and leaves at the bottom, passing through twice the length of tubes. The tubes are 3-4 inch outside diameter, of No. 18 B. W. G. brass, tinned inside and out. The tube sheets are of Muntz metal.

The direct connected pumps on each engine are attached to the condenser and operated by links from the 1st I. P. crosshead. The main air pump is 30 1-2 inches diameter, and 30 inches stroke. The other direct connected pumps are: one 6-inch feed pump, one 6-inch bilge pump, and one 5-inch fire and sanitary pump. There is also a 4 1-2 inch diameter by 15-inch stroke hot salt water pump on port engine only. Aspinwall inertia governors are fitted on the pump levers, and connected to the butterfly valves.

The reversing gear is of the "all-round" type, double 7 1-2 inch by 7 1-2 inch engines, secured to the inboard 2d I. P. housing. They are connected by worm gearing to the reverse shaft just above. The reversing engines are quickly and easily started and stopped by the change valve between steam and exhaust lines. The reverse arms are fitted with slots to allow independent linking up of all engines.

The turning gear engines are duplicates of the reversing engines and secured to the inboard side of each condenser. They connect by double worm gearing to a cast steel gear on main shaft.

AUXILIARIES.

There are four main feed pumps of the vertical simplex double-acting piston type, 11 and 8 inches by 26 inches stroke, built by Dean Brothers. These are similar in style to the well-known Weir pumps. Steam to these pumps is regulated by an automatic float in the suction chambers. The two auxiliary feed pumps are vertical duplex—12 and 7 inches by 12 inches, and 9 and 6 inches by 10 inches, also built by Dean Brothers. The feed water, after leaving the main feed pumps, passes through a Quiggins feed heater of the vertical cylindrical type. Steam to the coils of the feed heater is taken from high pressure or from main feed pump exhaust as desired. From the feed heater the feed passes through a Railton & Campbell grease extractor of the cartridge type, thence to the main boilers, through main or auxiliary lines. Ample connections allow the feed water to be handled in almost any way desirable or necessary, cutting out heater and filter, one or both, working from main or auxiliary feed pumps or direct connected pumps.

The main circulating pumps are centrifugal, with connections 16 inches diameter, driven by independent 10 by 10-inch vertical engines of the New York Shipbuilding Company's designs. The ballast pump is vertical duplex 12 and 14 by 12 inches. Two other vertical duplex pumps 6 and 6 by 6 inches, and 5 1-4 and 4 by 5 inches are for pumping fresh water for the various uses required. The independent water service and sanitary pump is also vertical duplex 7 and 8 by 8 inches.

A Wheeler auxiliary condenser of 1,050 square feet cooling surface is located on the port side middle platform, with its own air and circulating pumps attached, size 10 by 12 and 12 by 12.

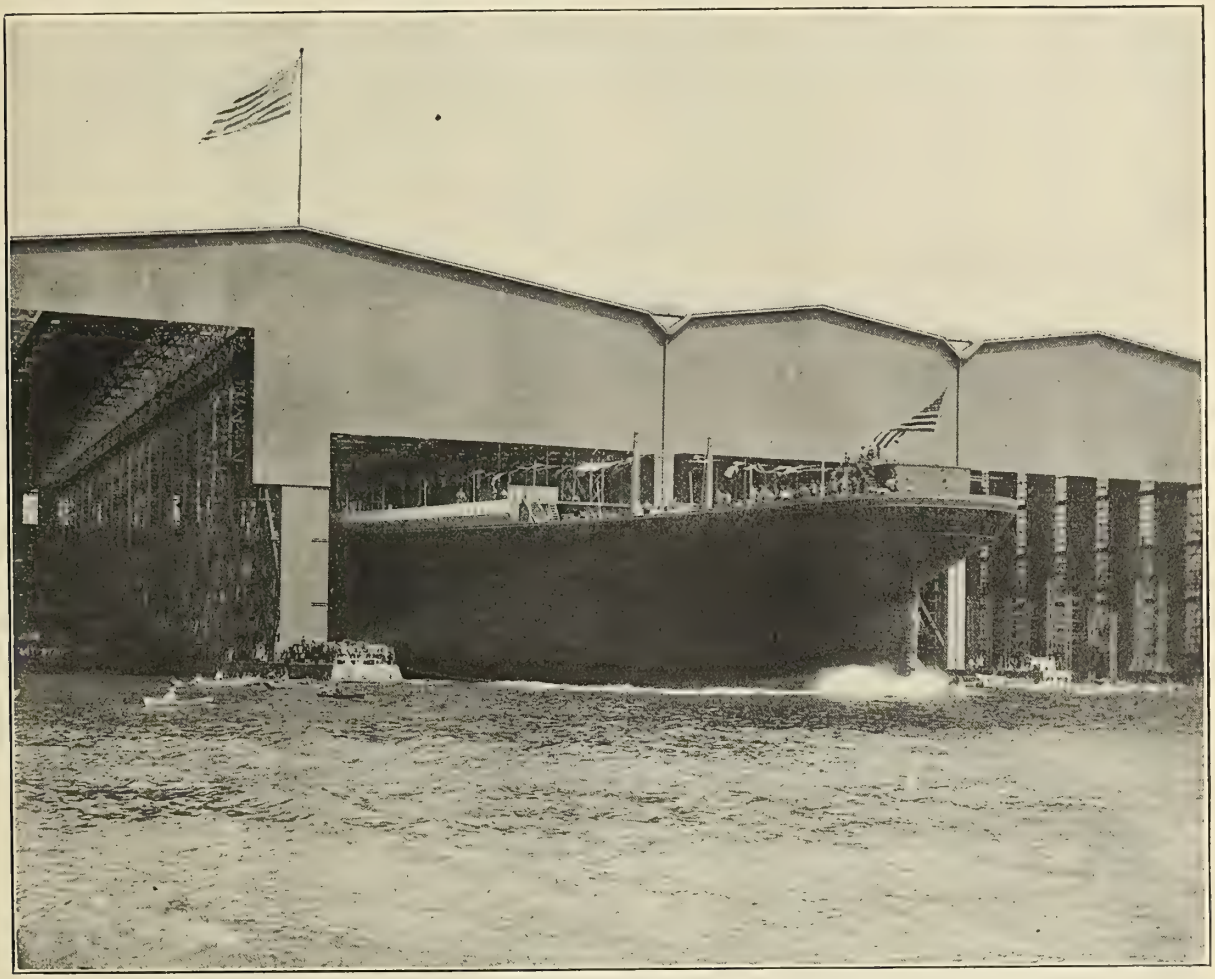
A Reilly evaporator is located below in forward end

of port engine room with a capacity of 50 tons of fresh boiler feed per 24 hours. In connection with this are the evaporator feed pump and two vertical cylindrical distillers of capacity of 5,000 gallons each per 24 hours. They are supplied with circulating water from the auxiliary duplex feed pumps or the ballast pump.

The electric lighting plant is located on a level with the middle platform in a recess aft of the main engine room. It consists of three General Electric Company's direct connected generators of 25 Kw. capacity each. The engines are compound, 6 1-2 and 10 1-2 inches by 7-inch stroke, and run at 400 revolutions. The generators are D. C. compound wound for pressure of 110 volts. The switchboard has the usual complete equipment of voltmeter, ammeters, ground detectors, circuit breakers, etc. There are over 900 lamps of 16 c. p. each.

The refrigerating plant is located below, aft of the main engine room in the space between the main shafts. The machine is built by the J. & E. Hall Company of England, and uses carbonic anhydride gas. The engine is cross compound, cylinders 11 and 22 inches with 15 inches stroke. The compression cylinders are of wrought steel, arranged in tandum with the steam cylinders. The bed plate of the machine is made large so as to incorporate the necessary auxiliaries. It contains the condenser for its own engine, also two condensers for the CO_2. The attached pumps consist of air pump for the engine condenser, feed pump to deliver discharge of same to feed tank, and circulating pump to supply cooling water for the condensers. An independent duplex pump 4 3-4 and 6 1-2 by 6 inches is also fitted for circulating the condensers when required.

The two evaporators for the refrigerating gas are located aft of the machine. The cold brine from these is circulated through the chambers by two vertical duplex 4 3-4 and 6 1-2 by 6-inch pumps. A complete distributing system of manifolds, with thermometers, allows the operation of the cold storage plant in any way desirable. The total refrigerated space is about 9,000 cubic feet. There is also an ice-making plant arranged for 20 cans of about 28 pounds each.



LAUNCHING OF THE STEAMSHIP MONGOLIA FROM THE COVERED SLIP AT THE NEW YORK SHIPBUILDING COMPANY.

A very completely-equipped machine shop is located on the upper deck abreast of the engine room on the port side. The machinery equipment consists of the following tools arranged to be driven by a vertical 6 1-2 by 7-inch New York Safety Power Company engine: 1 Kelly 16-inch shaping machine, 1 Barnes 25-inch drill press, 1 Slater sensitive drill, 1 double heavy emery wheel grinder, 1 16-inch back-geared screw-cutting lathe 14 feet between centers, 1 Forbes adjustable pipe-threading machine, 1 24-inch grindstone. The tool rooms are located on the middle deck abreast of the engine room.

BOILERS.

There are eight main boilers, Scotch return tubular type, built for a working pressure of 215 pounds. Four are double end, 19 feet, 4 5-8 inches long between heads, 14 feet 5 inches mean diameter, and four are single end, 10 feet 10 1-2 inches long between heads, of same diameter. The heating surface of the double-end boilers is 4,702 square feet each, and the single-end 2,367 square feet. The double-end ones have six furnaces 40 1-2 inches inside diameter, with a grate surface of 106 square feet, and the single-enders three furnaces, with 53 square feet grate surface.

The double-end boilers are located abreast of each other, just forward of the cross bunker that extends between engine and boiler rooms; the single ends are similarly arranged forward of these, facing them so the same fire-room serves for the forward end of double-enders and after end of single-enders. Chutes run from upper side bunkers to each side of the double fire-room. Another cross bunker extends across the ship forward of the boiler compartment, and a trolley service transports the coal from both the cross bunkers to fire-rooms.

A small auxiliaray boiler is located on the middle deck aft of the after fire-room hatch. It is single end, return tubular, of the dry-back type, 5 feet 6 inches diameter, 7 feet 4 inches between heads. The pressure is 215 pounds.

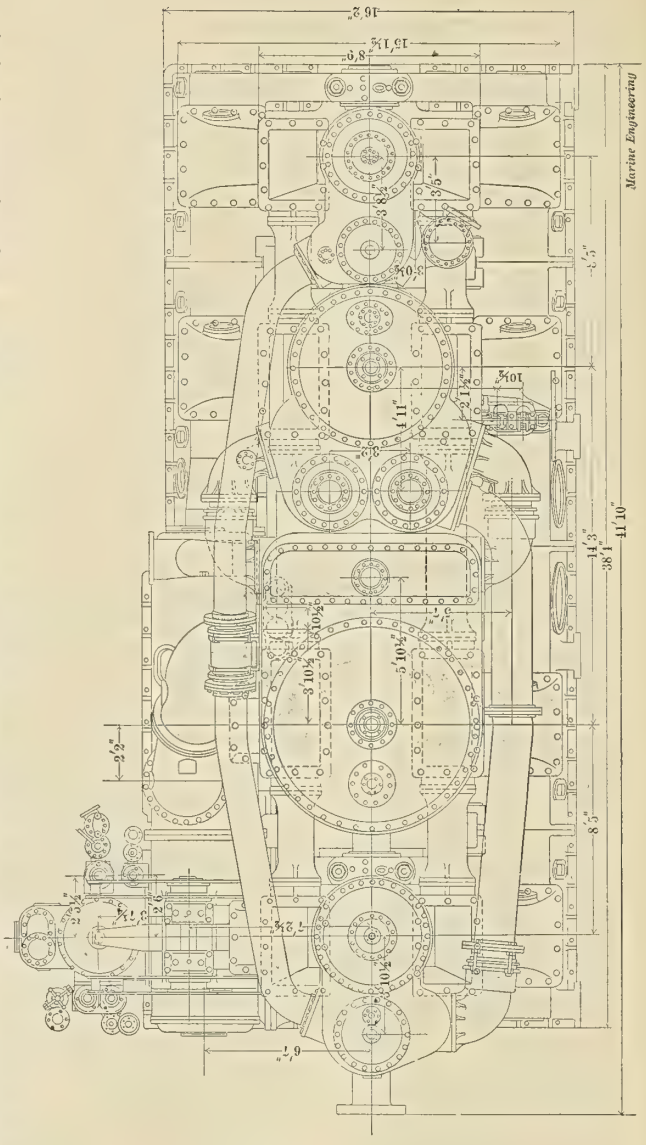
The main boilers are fitted with the New York Shipbuilding Company's heated forced draft. The results of the trial show this system to be very efficient and satisfactory. At no time was there any trouble in maintaining full boiler pressure for the maximum steam demand made by the engines. This was done with an air pressure of 1 inch in the ash pits. There are three Sturtevant blowers, 96 inches diameter, driven by double engines 8 1-4 by 5 1-2 inches stroke. One is located over each fire-room hatch on the grating below the shelter deck. Air is drawn from over the boilers and heated in the usual vertical tube heaters in the uptakes before being admitted to the furnaces. The uptakes all unite in a common smoke pipe of elliptical section, 10 feet 9 inches wide and 14 feet 3 inches fore and aft.

There is an 84-inch Sturtevant fan with 6 by 5-inch double engines provided for ventilating the fire rooms. The ash hoists are steam, of the direct lifting type. Large ash chutes are conveniently located inboard with continuous flushing arrangement.

The steam piping systems are carefully arranged and very complete, provision being made for overhauling without shutting down necessary auxiliaries, such as dynamoes. All the distributing systems can be operated from the manifolds in the engine room at the forward bulkhead. A reduced pressure of 100 pounds is used for all auxiliaries except main feed pumps.

DECK MACHIINERY.

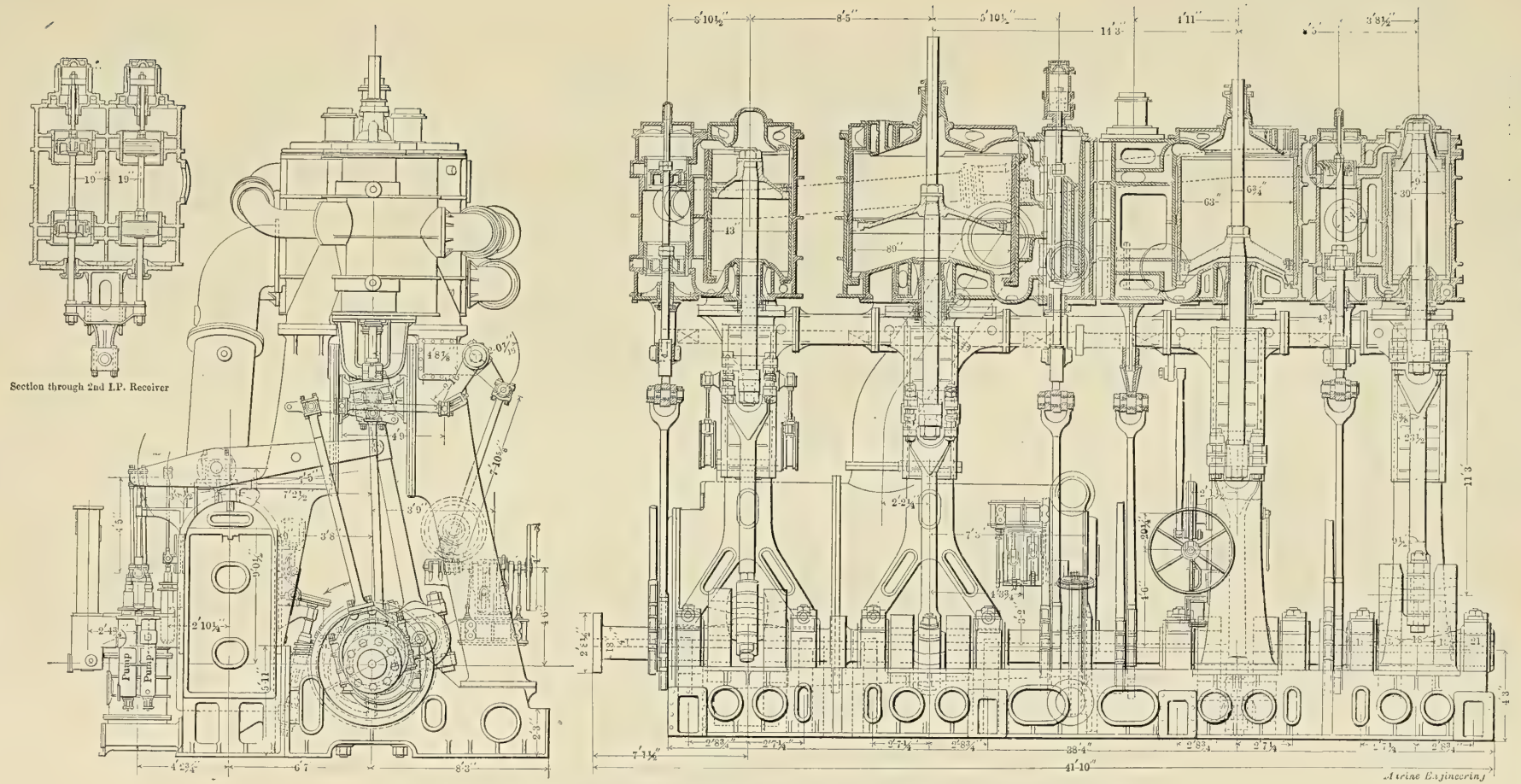
There are 19 winches of the horizontal double engine type, built by the Hyde-Windlass Company. Two each, with engines 8 by 14 inches are located at all hatches up to No. 9, while No. 10 has one with engines 10 by 16 inches. All these are fitted with gypsy heads, drums,



and change gearing as required for the service intended.

The anchor windlass engines are located on the upper deck. They are vertical, 18 by 14 inches, also of the Hyde type. The windlass is located on the shelter deck and receives its motion from the engines through bevel and worm gearing. It is extremely massive and strong to suit the requirements of so large a ship.

The steering engines are located aft in the deck house provided for same. They are built by the Williamson Brothers from type used by Harlan & Wolff. There are two complete double vertical engines mounted on sliding beds, so arranged that either may be brought into or thrown out of gear as desired. This is accomplished by means of adjusting screws which move the whole engine bed, the steam pipe being run in circular loops to admit the necessary movement. Each engine is double, 13 by 14 inches, with piston valves, and the usual arrangement of floating change valve to control movement. The engines are connected to the rudder quadrant by means of bevel gears between the horizontal



THE PORT SET OF THE FOUR-CYLINDER TRIPLE EXPANSION ENGINES FOR THE STEAMSHIP MONGOLIA.

and vertical auxiliary shafts for each engine. The gearing and all other parts are of ample weight and strength. The quadrant connects to the tiller proper through heavy coil springs which take up jar. The reversing valve of the steering engine is controlled from the bridge through shafting and bevel gearing. They can also be controlled from the after bridge or engines direct. No hand steering gear is provided, but a spare tiller is fitted and arranged for tackle connection with the after winch.

Ample provision is made everywhere for sanitation and ventilation. There is a Clayton fire-extinguishing and fumigating apparatus on the upper deck aft of the engine room. It consists of a gas generator and direct connected blower and engine with the necessary pipe connection to the holds and compartments. This can be used to send gas for either purpose anywhere throughout the ship.

Strength of Our Navy.

Mr. Hale, chairman of the Senate Naval Committee, gave some interesting figures on the strength of the United States Navy, when the Navy appropriation bill was under discussion in the Senate on March 3. The present bill, which provides for the construction of one 16,000-ton battleship, two armored cruisers, three fast scout ships, and two colliers, calls for an expenditure of $97,001,738.94.

The total provision for increase of the Navy in 1883 was 13,000 tons, less than a modern battleship. From that time appropriations had been made year by year, providing for cruisers and first-class battleships, down to 1900.

"We have appropriated since 1884 for the new Navy $760,896,567.75," said Mr. Hale. "As showing the growth of the navy in another respect, I have the list of men and petty officers. In 1883 the Navy consisted of 8,250 men and petty officers. We now have 34,000. The pay of the Navy in 1883 was $6,940,780, and last year it was $19,824,083." He then gave a summary of all vessels in the Navy fit for service, 254 in all, and 43 others under construction or authorized. Twenty-three vessels, in addition were unfit for service. The total tonnage of the Navy in service is 531,886. The tonnage under construction is 394,431, making a total of 881.317, tons, of 1,248,386 horse power, requiring 45,881 men.

In reply to a question Mr. Hale said that United States was ahead of Germany, not counting vessels under construction; that many obsolete vessels were carried in foreign navy lists as available and effective tonnage, while this was not done in our Navy. The offensive fighting ships of the United States as compared with similar ships abroad placed the American navy, in his opinion, next to that of England alone. "When the programme is completed," he added, "the United States will be way beyond France, or Germany, or Russia, or Japan, and much nearer Great Britain than anybody realizes who has not studied these figures."

Mr. Hale remarked that it was surprising how soon naval boards retired useful vessels from the offensive line and placed them on the list of defensive vessels. "The Navy Department is already talking of placing the *Oregon, Massachusetts* and *Indiana* on the retired list as harbor defence vessels. Nothing suits the Navy officers but the very largest and finest ships. There is not on the seas a single battleship of 16,000 tons, yet we are building nothing else."

Erata.—In the drawing illustrating "Electricity on Shipboard," page 73, February, 1904, the left hand connection of switch *B* should be to the top line, running from left to right instead of to the third line, as shown.

MARINE ENGINEERING DATA CARD. APRIL, 1904.

NAME—Mongolia and Manchuria. NATIONALITY—American. TYPE—Ocean passenger and freight.
LAUNCHED—1903. BUILDER—New York Shipbuilding Co. OWNER—Pacific Mail Steamship Co.

Length over all	615 ft. 8 in.
" between perps	600 " 0 "
Breadth, molded	65 " 0 "
Depth, molded to upper deck	43 " 3 "
" to shelter deck	51 " 3 "
Draft, load	33 " 6 "
Displacement, load	26,514 tons
" launching, includ g cradle	9,487 "
Gross tons	13,636 "
Block coefficient, about	.69
Water ballast, double bottom	2,270 tons
" three deep tanks	2,330 "
Coal bunker capacity, normal	1,950 tons
Total capacity	4,750 "
Speed, sea, load draft	15 knots

Engines: Number 2
Cylinders, diameters 30, 43, 63, and 89 ins.
Type four-cylinder, quadruple
Valves, piston except L. P.; Stephenson gear.
Stroke 60 in.
I. H. P., at sea 10,000
Revolutions at sea 80
Shafting: Crank, diameter 18 in., 4-in. hole
Line, diameter 17 1-8 " 6-in. "
Thrust, " 28 1-4 and 17 3-4 " 6-in. "
Propeller, mean 18 1-4 " 6-in. "
Cooling surface, each engine, 7,500 sq. ft.
Air pump, direct-connected, diameter, 30 1-2 in.

MARINE ENGINEERING DATA CARD. APRIL, 1904.

NAME—Mongolia and Manchuria. NATIONALITY—American. TYPE—Ocean passenger and freight.
LAUNCHED—1903. BUILDER—New York Shipbuilding Co. OWNER—Pacific Mail Steamship Co.

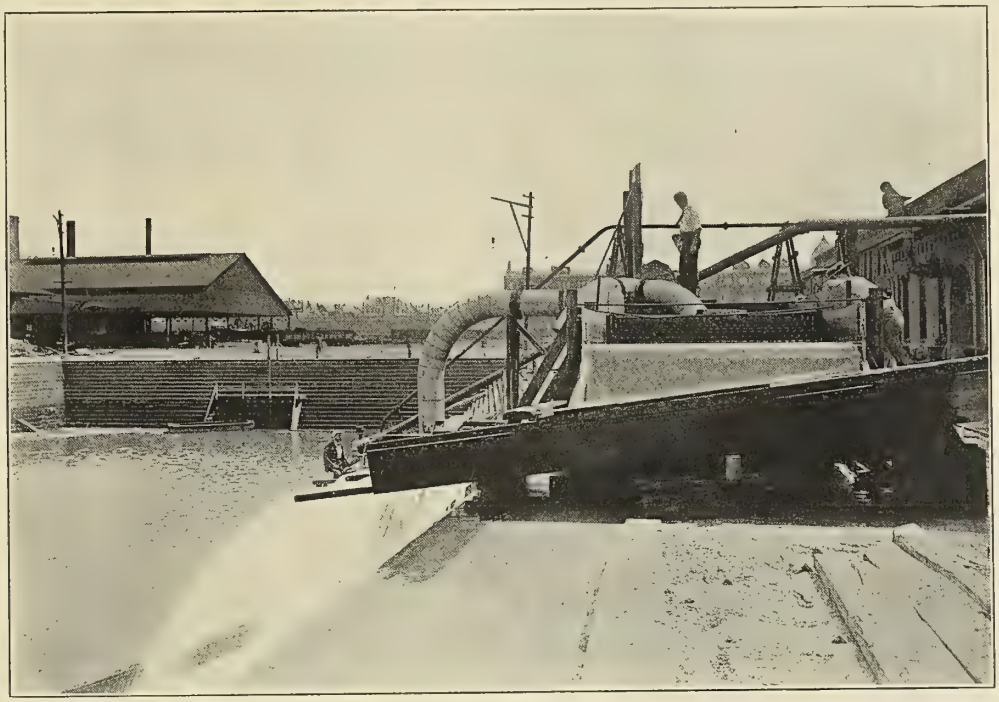
Propellers: Number	Two 3 blades each
Diameter	18 ft. 6 in.
Pitch	23 " 6 "
Helicoidal area, each wheel	86.6 sq. ft.
Boilers: Working pressure	215 lbs.
Scotch,	4 single-end, 4 double-end
Diam., mean,	14 ft. 5 ins.
Length,	10 ft. 10 1-2 in., 19 ft. 4 5-8 in.
Tubes, diam.,	2 1-2 ins.
" number,	410 820
" length over all,	7 ft. 6 1-2 in., 7 ft. 10 1-8 in.
Thickness, stay tubes, 1-4 in.; plain, No. 8 B. W. G.	
Furnaces: Inside diam.	40 1-2 in.
Number, each	3 single-end, 6 double-end
Length of grates	5 ft. 3 in.
Heated forced draft	
H. S., each	2,367 sq. ft., 4,702 sq. ft.
Total,	28,276 sq. ft.
G. S., each	53 sq. ft. 106 sq. ft.
Total,	1,036 sq. ft.
H. S. ÷ G. S.,	44.5
I. H. P. ÷ G. S.,	15.75
H. S. ÷ I. H. P.,	2.8

Test of Centrifugal Pump.

BY P. P. BIRD.

To measure the discharge of a centrifugal pump discharging 15,000 gallons of water per minute, presents some difficulties to the engineer which may properly be discussed here. The following description and pictures illustrate the methods recently used in testing a pump for the armored cruiser *West Virginia,* at the yard of the Newport News Shipbuilding & Dry Dock Company, at Newport News, Virginia.

The centrifugal pumps, as installed in the engine rooms of a modern warship, have as their primary object the circulation of cooling water through the condensers. However, they are also arranged so that their suctions



ARRANGEMENT FOR CAPACITY TEST OF CENTRIFUGAL PUMP FOR CRUISER WEST VIRGINIA. RUNNING AT MINIMUM DISCHARGE.

are connected to the drainage system of the ship, and also to the bilge at that point. Further, the specifications for the *West Virginia* class state that each pump shall be capable of discharging overboard a certain number of gallons of water per minute from the lowest point of the bilge suction. They further state that "the pumps will be tested by discharging water under conditions as nearly as possible like those they will be working under when throwing water from the bilges. They must discharge water at the same height as the water line is above the pumps and through the same length and size of pipe, drawing water from the same depth as the lowest part of the bilge suction pipe below the pump and through the same length and size of pipe."

In the case of the pump above referred to the specifications required a discharge of 15,000 gallons of water per minute, the revolutions for such outfit not exceeding 266 per minute.

Previous experience had shown the difficulty of testing a pump of this sort with its suction within the influence of the tide. As with the pump on the pier the continually changing suction head seriously interferred with the uniformity of testing. Also with the pump mounted on a float, the immense weight of water in the system would result in not only considerably shortening the lift of the pump, but in giving the float a bad list, unless previously provided for. Further, when testing a pump on the pier or on a float, it had been found difficult to get good steam or vaccum to approximate the conditions obtainable aboard ship. A pump of this kind when in service conditions, of course, is below the water line, and being always immersed, will start without priming. However, when located above the water line, it is necessary to run the pump very fast, considerably above the normal speed, for some minutes before it will "take hold" of the water and pump. This means using an immense quantity of steam before actually starting the test, enough to empty a small portable boiler, such as would be found available around the piers.

The above difficulties made it desirable to locate the pump for testing in such a way as to maintain practically uniform conditions as to heads throughout the test, and also to get the pump near a good supply of steam, and if possible where the engine could be connected to a condenser.

Fortunately there was at the disposal of those making this test a dry dock with a power house located close at hand. Accordingly the pump was installed on the slope of the dry dock at a point near the steam and vaccum supply.

Three methods of measuring the water discharged were considered:—

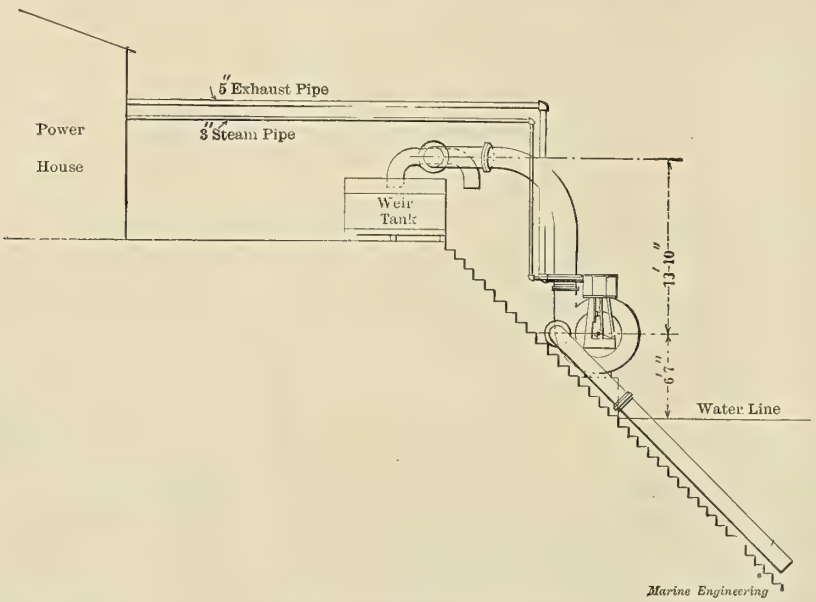
1st. By measuring the velocity of flow in the discharge pipe. This could be done in several ways, *i. e.,* by means of a small propeller wheel placed in the pipe and assuming a slip, or by Venturi meter, or by Pitot's tube.

2d. By pumping a known quantity of water, enough to fill a dry dock for instance, and

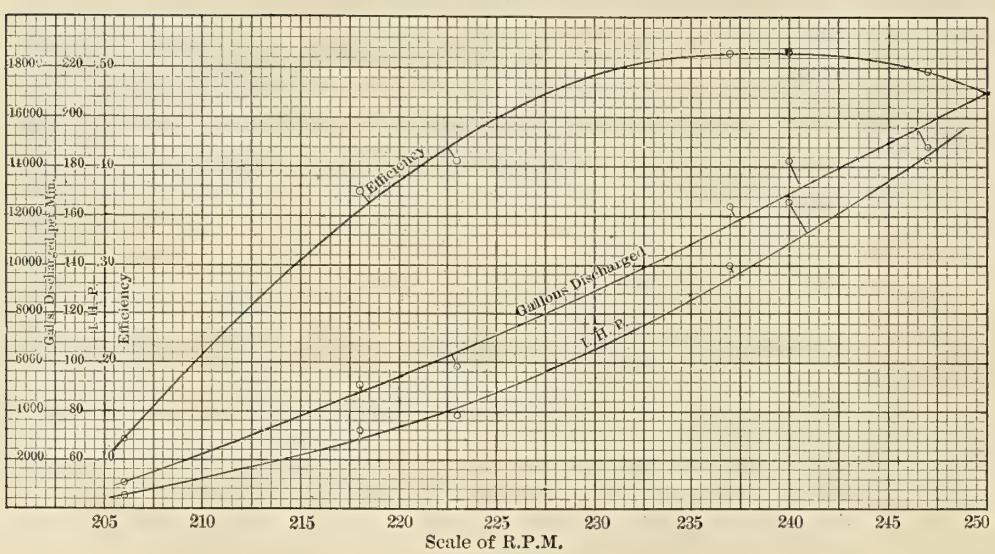
3d. By pumping into a tank and discharging from this over a weir.

The latter method had been successfully used before with a smaller pump and was adopted in this case. As it was desirable to use the tank which had been made for the previous test and as this tank was too small to charge head when pumping into the tank, which was placed alongside the dock on the ground level.

By referring to the arrangement drawings, the vertical distance from the center of the pump, as to be installed on ship, to the water line at trial displacement, was found to be 13 feet 10 inches. This gave the necessary discharge head and in the test was the vertical distance from the center of the pump to the highest point in the



PIPE PLAN FOR CENTRIFUGAL PUMP TEST.



CURVES OF CAPACITY, HORSE POWER AND EFFICIENCY FOR CENTRIFUGAL PUMP TEST.

take the full discharge of this large pump, the 21-inch discharge pipe was divided into two 15-inch pipes—one only of which discharged into the tank, it being assumed that the discharge was equally divided, and that the observed readings on the weir would indicate half the total discharge.

The pump was located for the test at a point far enough down in the dry dock to give the proper discharge pipe. The length of this pipe was made 31 feet, which was equal to the total length of the system discharged through aboard ship, from the flange on the pump to the skin of the ship.

Similarly from the drawings the vertical distance from the center of the pump to the bottom of the nozzle of valve in main drainage line in the engine room was found to be 6 feet 7 inches. This gave the necessary lift

of the pump—accordingly, the dry dock was flooded to a point this distance below the pump. The two 15 1-2 inch suction pipes were run down in the dock some distance below the water level—so as to give the same length of pipe as used aboard ship. This was found from the drawings to be 31 feet 3 inches.

All of the water pumped drained back into the dry dock, so the conditions were constant throughout the trial.

The pump was driven by a direct connected vertical compound engine, the diameter of the high pressure cylinder being 11 inches, the diameter of the low pressure cylinder 22 inches and the stroke 10 inches.

The cranks were at right angles to each other. Steam is admitted to the high pressure cylinder by a piston valve, and to the low pressure cylinder by a slide valve. The steam pipe running from the power house was 3 inches in diameter and the exhaust pipe 5 inches in diameter.

The diameter of the pump fan was 45 inches and the width at periphery was 4 inches. There were six valves.

ENGINE DATA.

No.	Time.	Steam Press.	Vacuum	R.P.M.	M.E.P.		I.H.P.		Total I.H.P.	M.E.P. to Low.
					H.P.	L.P.	H.P.	L.P.		
1	10-25	112	18½	206	20.83	6.50	20 2	25.6	45.8	11 60
2	10-40	113	17½	218	34.13	8 88	34 95	36.95	71.9	17.20
3	10 35	113	17½	223	36 65	9 66	38 4	41.1	79.5	18.60
4	10-40	112	15½	237	57.50	16.82	64 0	76.1	140.1	30.80
5	10 48	113	15	240	61.05	21.20	68 9	97.1	166.0	36.10
6	10-57	118	15	247	65 50	22 73	75 6	107.1	183 1	38.65

During Card No. 6 the bypass valve was open, admitting live steam to the receiver.

WEIR DATA.

Time.	Head on Weir.	Cu. ft. over weir per Sec.	Cu. ft Discharge by Pump per Sec.	Gallons Discharged per Min.	Velocity of Discharge.	Velocity Head.	Total Head.	Water H. P.	I. H. P.	Eff.
10-25	1.5″	1.18	2.36	1 060	Small neglect	0	20.42	5.61	45.8	12.24
10-30	4.25	5.62	11.24	5 044	4.68	.34	20 76	27.1	71.9	37.7
10-35	4.75	6.61	13.22	5,940	5.50	.47	20.88	32.1	79.5	40.4
10-40	7.75	13.82	27.64	12,420	11.50	2.05	22.47	72.2	140.1	51.5
10-48	8.50	15.90	31.80	14,270	13.22	2.72	23.13	85.5	166.0	51.5
10-57	8.75	16.60	33.20	14 900	13.78	2.95	23.56	90.3	183.1	49.35

By referring to the above data it will be seen that the highest revolutions obtained were 247 at a steam pressure of 118 pounds per square inch. The working steam pressure for the engine aboard ship will be 150 pounds per square inch. At 247 revolutions per minute 14,900 gallons of water were pumped. The curve of revolutions and discharge shows that the pump was of ample size to meet the requirements.

The Francis formula which was used in figuring the weir discharge is

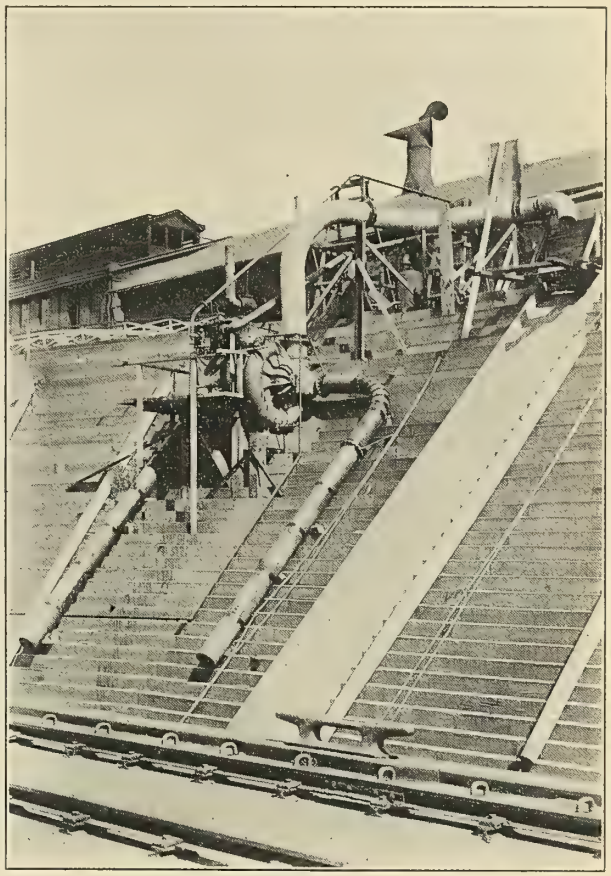
$$Q = 3.33\ L\ H^{\frac{3}{2}}$$

Where Q is the discharge in cubic feet per second.
L is the length of weir in feet, equal to 8 in this case.
H is the observed head over weir in feet.
No correction was made for the velocity of approach. Of course this would have been in favor of the pump. The velocity formulas are:

$$\text{Velocity of discharge} = \frac{\text{Pump discharge in cu. ft. per sec.}}{\text{Area of discharge in sq. ft.}}$$

$$\text{Velocity head} = \frac{(\text{Velocity of Discharge})^2}{64.4}$$

The constant static head was 6 feet 7 inches lift plus 13 feet 10 inches discharge, equal to 20 feet 5 inches. The total head in each case was the velocity head plus the constant static head. The head due to friction was neglected as the pipes were so short.



VIEW OF THE PUMP, SUCTION AND DISCHARGE PIPES.

$$\text{Water horse power} = \frac{(\text{Gals. per min.}) \times (\text{total head}) \times 8.54}{33{,}000}$$

$$\text{Efficiency} = \frac{\text{Water horse power}}{\text{Indicated horse power.}}$$

An attempt was made to measure the velocity of discharge by inserting a Pitot tube in the 21-inch discharge pipe. The values of the discharge corresponding to the velocities obtained in this way were slightly in excess of those obtained from the weir measurements. This was to be expected as no correction had been made for the velocity of approach to the weir.

The pipes used in the test were made of riveted sheet steel and all seams in the suction pipes carefully calked.

English Shipbuilding Notes.

The number of shipbuilding contracts recently placed, principally with builders on the north-east coast of England, has been matter for surprise in view of the very considerable depression in the shipping trade and the lowness of freights. One reason given is the very exceptionally low prices which have been accepted. Some of the vessels of about 6,000 tons dead-weight carrying capacity having been contracted for at the rate of £.12.6 per ton. Very long terms too are being accepted by some of the shipbuilders for payment for these ships. It has long been the practice for firms to accept bills, payable a year or so after the completion of the ship, but in some of the recent cases the payments are to extend over 7 and even 10 years after completion. This is a dangerous element which ought to be checked, as speculative shipowners will be encouraged to enter the market, not so much to supply their legitimate needs as to enable them to conduct a brokers business and in this way it is possible that the future may be very heavily mortgaged for the present, whereby a legitimate recovery of sound business would be materially postponed. Other dangers are almost self-evident, so that it is not necessary to point to them.

Lloyd's register of shipping has just issued an interesting return showing the balance sheet of British mercantile tonnage and from this it is seen that the fleet now numbers 20,464 vessels of 15,773,981 tons. The gain in ten years is about 27 per cent. The number of sailing vessels has very considerably decreased, while the number of steamers has increased and at the same time the carrying capacity of the average ship has greatly developed. The British merchant marine, it is therefore accepted, increases at the rate of 5 per cent. per annum. One remarkable fact is that the new vessels account for a much greater increase than this 5 per cent., and the explanation is to be found in the circumstance that foreigners buy each year a large proportion of more or less obsolete tonnage. Thus during the past year 300,574 tons were sold to foreigners, and of these 34 per cent. were vessels built prior to 1880, 59 per cent. prior to 1885 and 71 per cent. prior to 1890. The fact that such old vessels in the hands of foreign owners compete with British ships has again given rise to the contention that shipping legislation applicable in British harbors to vessels owned by that country militates against their successful competition, and a plea is again being put forward that Parliament should amend in some measure this unequal condition. The president of the Board of Trade, in whom is vested such matters, has been invited by a deputation of owners to apply the restrictions as to loadline and free-board to foreign ships engaged in the British trade as well as to ships flying the Union Jack, and it is very probable that this one of the most important disabilities under which English ships work in competition with foreigners will be removed.

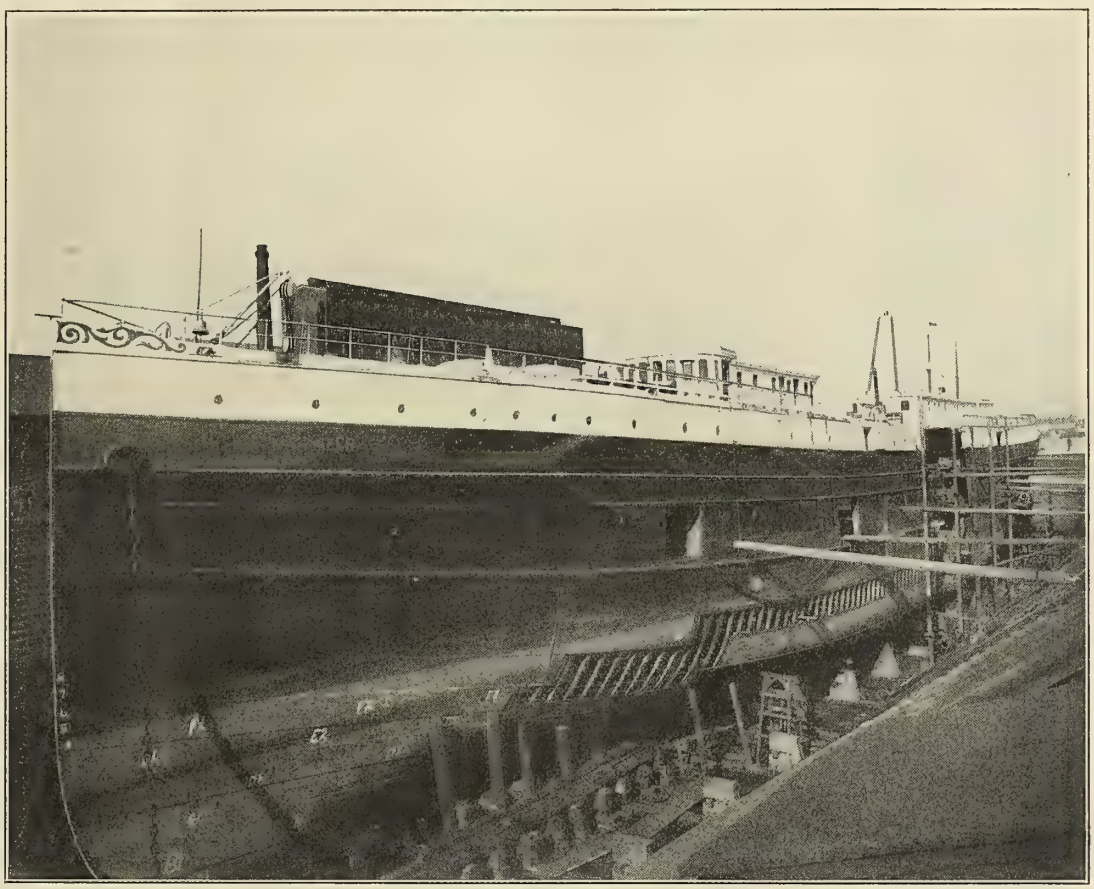
The Institution of Naval Architects which meets towards the end of March is now arranging its programme, and it is anticipated that there will be a "battle royal" between those two giants in the profession, Sir William H. White and Sir Edward J. Reed. The former, it will be remembered, succeeded the latter at the Admiralty, and Sir Edward Reed has since designed many ships for foreign navies, principally those of the South American republics. In these vessels it is claimed he succeeded in introducing a greater gun power, if not also a higher speed, than is the case with the British ships designed by Sir William White. The latest of Sir Edward's ships—the two Chilian battleships recently bought by the British Government—are to form the subject of a paper to be read by him at the forthcoming meeting and as already both the naval architects named have had a "an affair of outposts," so to speak, in the public press, Sir Edward Reed's comparison of the Chilian ships with those of British design is certain to give rise to a lively, if somewhat inconclusive, discussion.

Considerable interest is being taken amongst the profession in the various visits to be paid to America during this year in connection, principally, with the St. Louis Exhibition. Neither the Institution of Marine Engineers, nor the Institution of Naval Architects will meet in America, but many of the members will visit the States along with other institutions. The first visit to be paid will be that of the Institution of Mechanical Engineers who are to meet at Chicago in the first days of June along with the American Society; already over 200 British members have signified their intention of being present and while no official visit will be paid to the Exhibition, many of the members will go there and with personal introductions from the Secretary of the American Society, Professor Hutton, they will visit many works. The Institution of Civil Engineers arrive in New York early in September. No meetings for the reading of papers will be held, but the Institution will pay a visit of courtesy to the American Society at New York. The Iron and Steel Institute will hold their meetings at New York on October 24th, 25th and 26th, and already between six and seven hundred have promised to attend. The fact that Mr. Andrew Carnegie is this year the president will further invest the proceedings with interest. The British Society of Chemical Industry will meet at New York on the 8th of September, and the Société des Ingenieurs Civils de France leave Havre on the 20th of August. Like the members of the institution of Civil Engineers those of the French Society will travel together in one steamer, whereas the members of other Institutions will proceed to New York as they choose.

It is worth noting that the first naval power to suffer from torpedoes in modern warfare, viz., the Russians, was the first to have made some effort to protect its ships by armor against torpedo attack, but unfortunately none of the ships in which this protection has been incorporated are yet ready. The five vessels of the *Borodino* class, now being completed in the Baltic, have their broadside protected with hardened nickel steel 1 1-2 inches thick, from the bottom of the main belt to near the turn of the bilge, with a view to minimising to some extent the effect of the explosion of the charge of the torpedo. The main belt is nine inches thick, tapering to 6 inches thick at the ends, with an auxiliary belt above that of 4 inches. It is a pity that these ships were not ready so that the efficiency of this light armor might have been tested in actual warfare.

Lengthening the Steamer Decatur H. Miller.

A naval architect is called upon to solve many unusual problems, but probably the most interesting is that of lengthening a steamer. With the increased efficiency of the modern ship over her old-time sister, and the decreased freight rates, it is generally the rule that the old ships are scarcely able to be run in competition on any profit to the owners. In such cases it is frequently found that by lengthening a steamer and increasing her carrying capacity, the ship will be good for several more years of profitable service. The first consideration, of course, is whether the condition of the hull is such that it will last long enough to warrant the expense of lengthening.



STEAMER DECATUR H. MILLER AFTER SHE WAS CUT IN TWO FOR LENGTHENING.

There has just been completed by the Maryland Steel Company, Sparrows Point, Md., the lengthening of the steamer *Decatur H. Miller,* one of the fleet of the Merchants and Miners Transportation Company. This ship was built of iron in 1879 at the Harlan & Hollingsworth Company, Wilmington, Del., at a time when iron and not steel was used in ship construction. The registered dimensions of the old ship were: Length, 250 feet; beam, 38 feet 6 inches; depth, 25 feet 3 inches; and net tonnage, 1,675 tons. The present dimensions of the vessel are the same, excepting that the length is 280 feet.

The *Miller* arrived at the yards of the Maryland Steel Company on November 23, 1903, and a force of men was immediately put to work taking off fittings, stack, up-take, etc., and the boilers were lifted on December 3. Four days later the ship was towed to the yard of the Baltimore Shipbuilding and Dry Dock Company, to which company the contract for docking work had been sublet. On December 9 the ship was floated into a dock and as soon as dry was attacked by a force of workmen, who commenced cutting out rivets in shell, deck, keelsons, and so forth. To such good effect was this work accomplished that notwithstanding the handicap of bad weather, all preparations were completed and everything ship-shape for pulling the bow, on December 19.

The power for this was supplied by four hand windlasses, well fastened to piles at head of dock, and each manned by sixteen men. From these windlasses the lines led to tackles of 14-inch treble blocks. Two of these were connected, one on each side, to the anchor chains, and two at forward cargo ports. The latter were made fast to heavy chains rove through the forward ports and along the side of ship and back again through another pair of cargo ports further aft. A fifth tackle was made fast to a forged shackle with bolt through the stern near the line of keel. The hauling part of this tackle was taken by a yard crane. The ground and sliding ways were of ample size and a stop was placed 30 feet from the starting point. When all

was in readiness, the winches were started and the fore body was pulled to the head of the dock. So well managed was the operation that the bow portion was brought to rest when the sliding ways were within one-eighth of an inch of stop. The time from start to stop was 37 minutes. It having been observed that in cutting apart, the bow had drooped slightly, the ways were arranged on a gradual incline, which corrected this and made it possible to obtain a fair sheer line. Test lines were run as soon as the ship was at rest, and the only difference perceptible was a spreading of the after part of the bow portion (through the woodwork), amounting to one-eighth of an inch. Sights were arranged before pulling, but on trying these afterwards it was impossible to perceive any variation.

Work was soon under way towards closing up the big gap made, and on February 9 water was admitted to the dock and the *Miller* taken out, 30 feet longer than when she entered.

When entering the dock marks were placed on the bow and stern at water-line, and measurements made when floated, the ship after lengthening showed a decrease in draft of 12 inches forward and 6 inches aft, due to the added length.

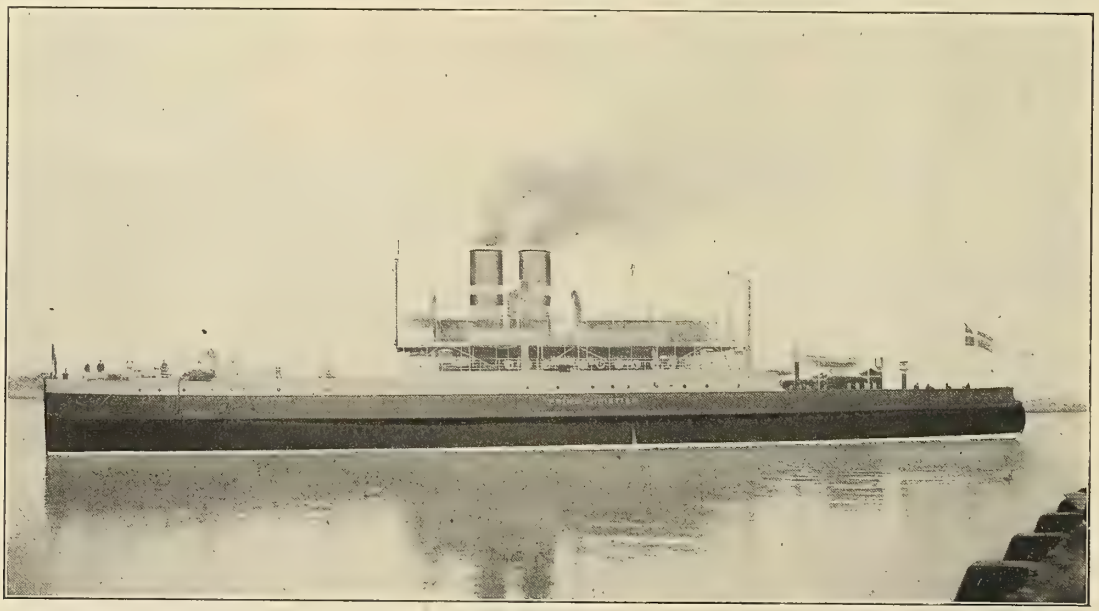
In addition to the new material occasioned by the extra length, there were 88 plates taken off and replaced, bilge keels 80 feet long fitted, and two new cargo ports cut.

The ship has since been towed to the yards of Maryland Steel Company, where the ship-carpentry, joinery, plumbing, piping, and so forth, will be arranged in the new section, and four new boilers installed, together with new cylinders for main engine and sundry repairs to same.

Mr. Thomas M. Cornbrooks, naval architect, has superintended the repairs as representative of the builders, and Mr. John M. Blankenship as representative of the Merchants and Miners Transportation Company.

THE DANISH STEAM CAR FERRY PRINS CHRISTIAN.

The ferryboat *Prins Christian* was recently built at Elsinore, Denmark, by the Helsingor Iron Shipbuilding and Engineering Company, Ltd., for the traffic between Gjedser, Denmark, and Warremunde, Germany. She was ordered by the Danish governmental railroad to complete the newly projected direct route between Berlin and Copenhagen, which heretofore has been very tedious, owing to the transfer from the trains to small boats and to the frequently encountered heavy weather. The vessel was delivered about the middle of September, having been built in about twenty months. She is the largest ferry ever built in Denmark, and is the most valuable vessel turned out from the yard at Elsinore. Her over-all dimensions are 285 feet by 56 feet. She is supplied with twin screws worked by two sets of triple expansion engines, developing 2,600 I. H. P. On the trial a speed of upwards of 14 knots was obtained.

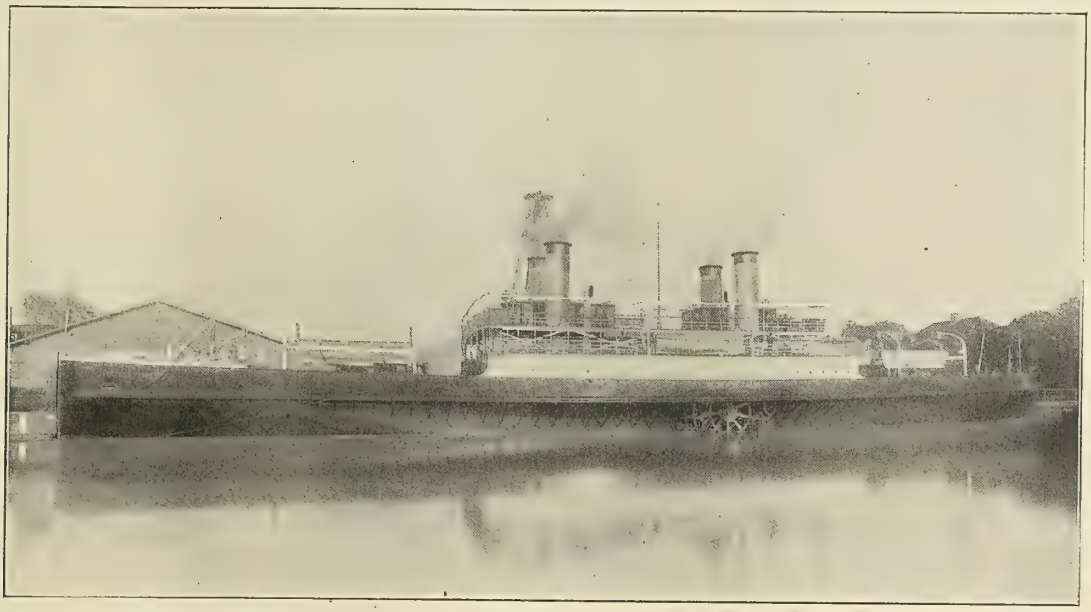


DANISH TWIN SCREW CAR FERRY PRINS CHRISTIAN FOR SERVICE ON THE BALTIC.

Everything has been done to study the comfort and accommodation of the passengers while on board this steamer. As the Baltic is frequently quite rough, the *Prins Christian* is furnished with very large bilge keels, which, together with some large balance tanks, tend to minimize rolling at sea. To effect shelter on deck, the bulwarks forward are built up to about 9 feet high, and above this a promenade deck is fitted amidships at a height of 16 feet above main deck. The general arrangement can be seen in the accompanying plans. A specially novel feature is the large port at the bow through which the cars pass. The entire bulwarks at the bow form a swinging port with axis thwartship, and operated by special machinery. When closed, the ports give the vessel the appearance of being built with a forecastle.

Two railway tracks are laid from end to end for the railway cars; at the ends these tracks converge to meet the corresponding tracks on the pier. From the cars

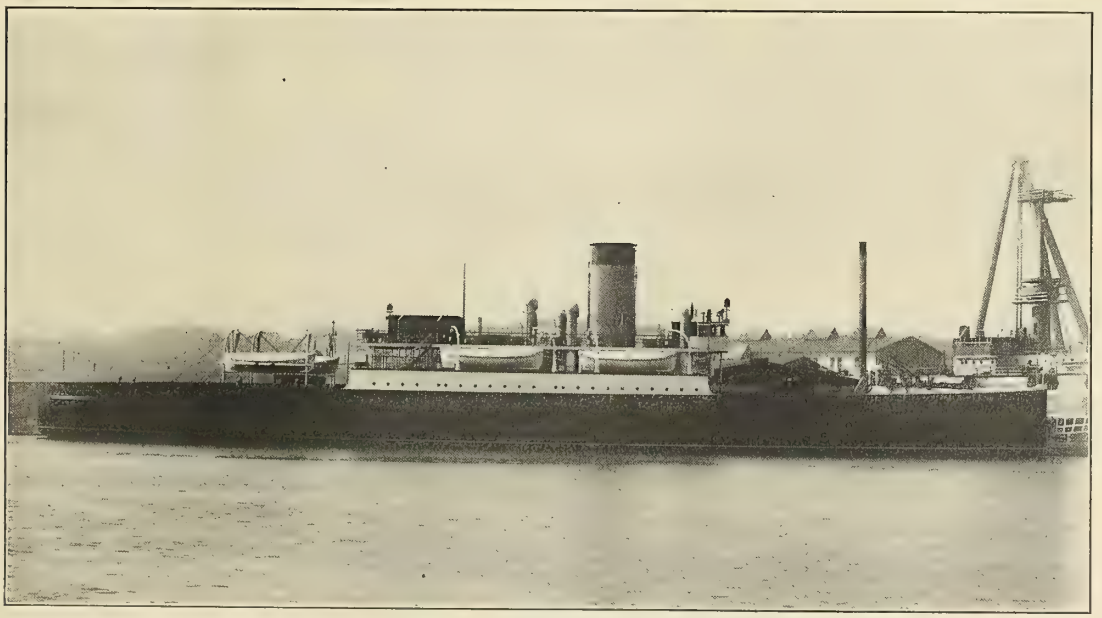
the passenger steps upon platforms in front of the main deck houses. These houses are built at the sides as in the older ferryboats, affording room for part of the crew, and the postal and railway clerks. Here, too, are



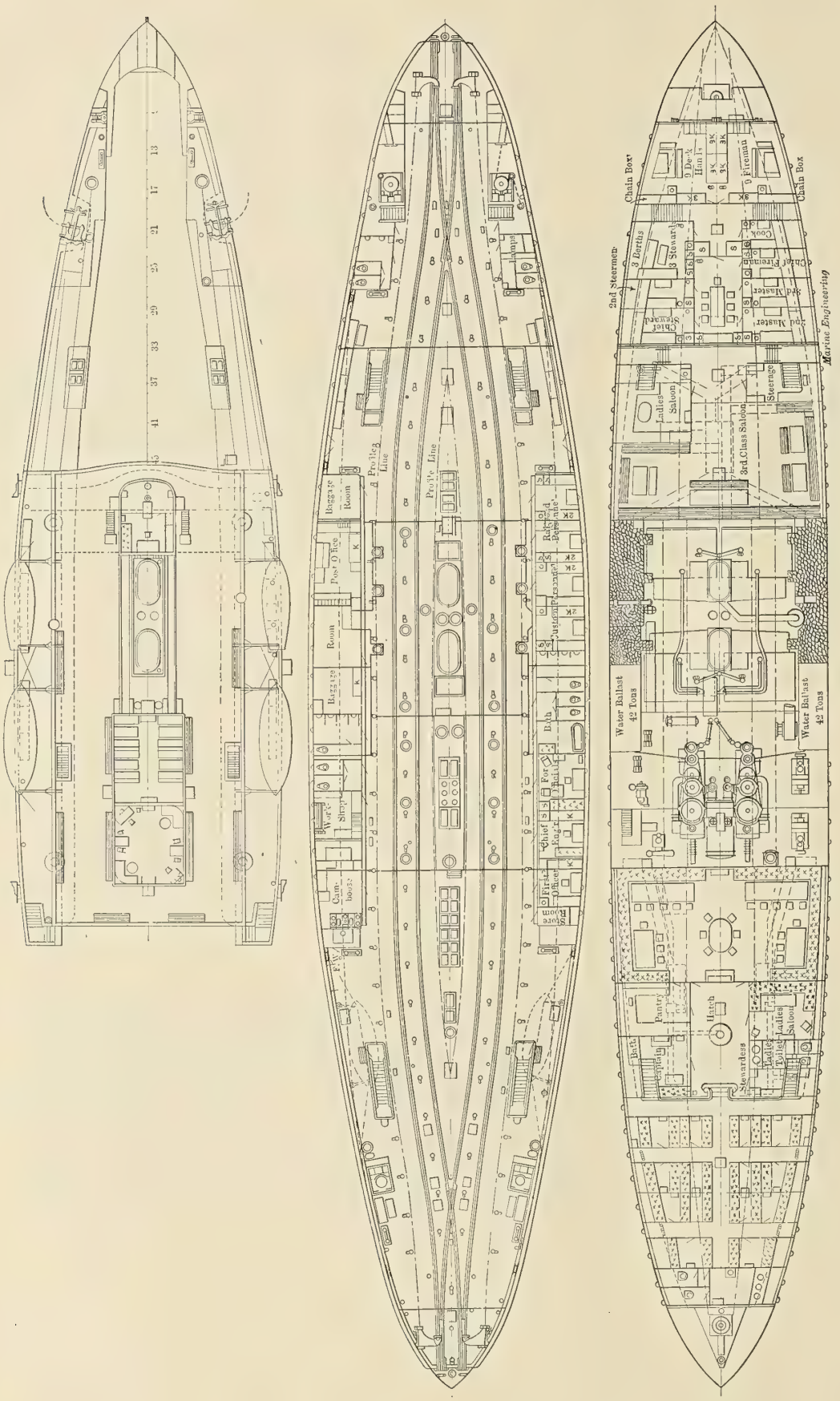
DANISH PADDLE WHEEL CAR FERRY PRINSESSE ALEXANDRINE.

workshop, post-office, toilet rooms, kitchen, and a private suite of rooms for officials. The cabin for the latter is furnished with white japanned walls, gilt mouldings and furniture of mahogany, a toilet room and water closet adjoin. The toilet rooms are fitted with tiled floors, marble wainscotting, and finest plumbing.

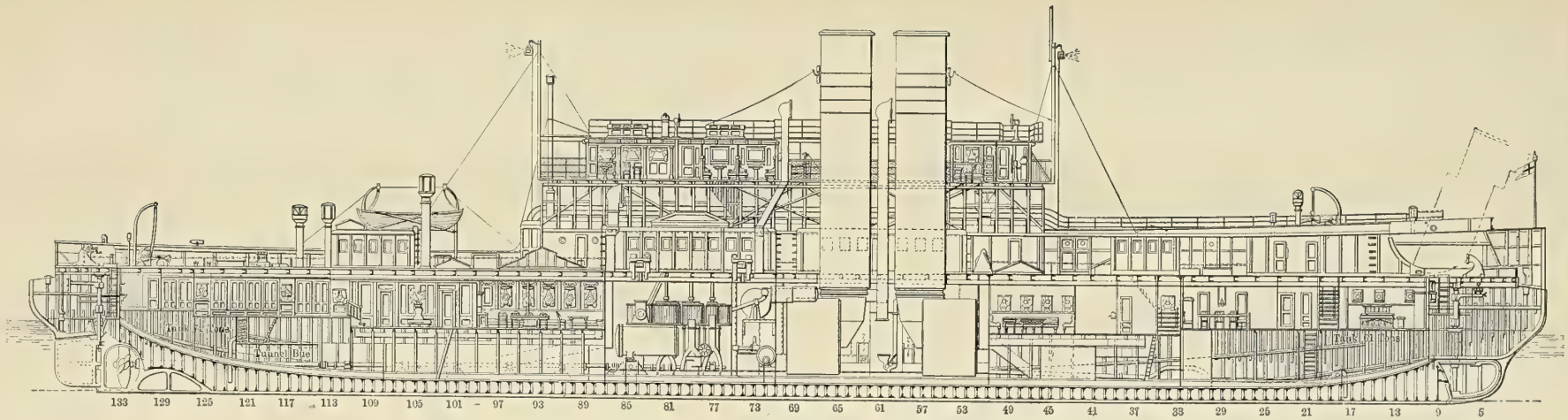
The whole of the space below maindeck and aft the engine-room is reserved to passengers of the first and second class. Two flights of stairs lead down from deck to a large lobby and well-lighted hall, handsomely finished in white japan with gilt trimmings. The floor here, as in other cabins of the vessel, is covered with linoleum and Brussels carpet. From the hall one passes forward into a very spacious dining saloon in fifteenth-century style, with furniture and walls of polished quartered oak. Doors from the hall lead to the pantry, the ladies' saloon, and the rooms of the captain and the stewardess, while a passage aft leads to the state-rooms,



THE TWIN SCREW CAR FERRY MECKLENBURG FOR THE DANISH GOVERNMENT RAILROAD.



DECK PLANS OF THE TWIN SCREW DANISH CAR FERRY PRINS CHRISTIAN. LENGTH OVER ALL, 258 FEET; SPEED, 14 KNOTS.

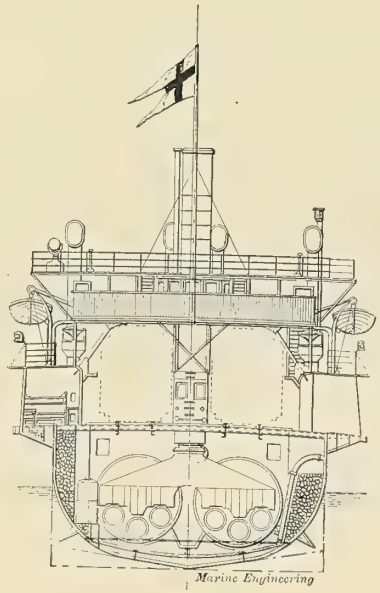


INBOARD PROFILE AND MIDSHIP SECTION OF DANISH STEEL CAR FERRY PRINS CHRISTIAN.

each of which is fitted for two persons and provided with sofas, folding washstands, luggage nets, etc. At the very stern are the gentlemen's lavatories.

At the forward end of the ship are the quarters for the crew, including staterooms for petty officers, toilets and mess-rooms. The third-class passengers' accommodations are between the crew space and boiler-room. Like the after cabins, they are well heated and ventilated by a complete system of steam coils and air ducts.

From the main deck, stairways lead to the tops of the deck houses, where are placed the life preservers. Over this deck are swung four lifeboats, suspended from automatic davits, which permit of rapid handling and require but one person to operate. A second stairway leads from these decks to the promenade amidships, as previously mentioned. This makes a splendid promenade 100 feet long by 40 feet in breadth and 25 feet above the water. Two teak deck houses are built here with large plate-glass windows. The forward one is the pilot house and chart room, which is just forward of the smokestacks, and the large after one contains the first cabin smoking room and the drawing room. The smoking room is finished in inlaid mahogany and fitted with leather-covered English sofas, while the saloon is beautifully paneled in white and gold with blue-plush furniture.



In order to carry the heavy loads of cars, the hull is built extra heavy, as is shown in the longitudinal elevation. The hull is divided into seven watertight compartments by six watertight bulkheads, which extend from the bottom to the main deck. The floors are continuous from side to side and are fitted with double reverse frames from end to end. The vertical center keelson is continuous and runs from forward collision bulkhead to after collision bulkhead, raising up at the bow and stern above the stern posts. It will be noted that at the bow a partially balanced rudder is fitted in the deadwood, as it is necessary to run backwards in going out of the harbor of Gjedser. Double frames of angle bar are spaced every two feet. The deck beams are placed on alternate frames and are of channel

section. A peak tank, containing 61 tons, is placed aft of collision bulkhead forward, and the after tank is 72 tons capacity. Wing coal bunkers are at the forward end of boiler-room, with chutes for filling from the main deck, and at after ends are two water ballast tanks, each containing 42 tons.

Steam is supplied by four single-end Scotch boilers fitted with natural draft. The uptakes lead to two elliptical funnels. A steam pipe from each boiler is carried to a steam drum, from which it is piped to the port and starboard engines. These engines are three-cylinder, triple-expansion, the high and intermediate pressures being fitted with piston valves, while the low-pressure cylinder has a double-ported slide valve. Steam exhausts to a common cylindrical condenser placed opposite the low-pressure cylinders on the center line of the vessel. Direct-acting air pumps are driven off the intermediate crossheads. Cylinders are supported by cast iron columns at the backs, *i. e.*, center of the ship, and forged steel columns at the face. A complete electric lighting system is installed.

Three other car ferries were placed upon this line shortly before the *Prins Christian* and resemble the latter in general arrangement. One, the *Mecklenburg*, is fitted with twin screws and two double-end Scotch boilers, and the other two, the *Friedrich Franz IV.* and the *Prinsesse Alexandrine*, are each fitted with feathering paddle wheels propelled by three-cylinder, triple-expansion inclined engines. There are two fire-rooms, one at either end of the engine space, and in each are placed two single-end Scotch boilers, each with its own smokestack. All three ships were built at the famous yard of F. Schicau, Elbing. The dimensions of these boats are as follows:

	Mecklenburg.	*Friedrich Franz IV.*	*Prinsesse Alexandrine.*
Length between perps..	262 ft. 0 ins.	265 ft. 6 ins.	264 ft. 0 ins.
Beam, molded	42 " 7 "	33 " 0 "	33 " 6 "
" over guards.....	54 " 0 "	57 " 2 "	57 " 2 "
Depth.....	21 " 4 "	18 " 10 "	18 " 7 "
Load draft.....	12 " 6 "	11 " 4 "	11 " 2 "
Height of rails above water at ends	10 " 2 "	10 " 2 "	10 " 2 "
Number of tracks on deck	Two.	One.	One.
I. H. P.....	2,500	2,500	2 500
R. P. M.....	.....	45	45
Speed, knots.....	13.5	13.5	13.5

Special Number of "Marine Review."—The *Marine Review* of March 12 is a special number devoted to the fitting out of ships and to a discussion of the shipping question in all of its various phases. The list of contributors embraces such prominent men as the Hon. George B. Cortelyou, Secretary Department of Commerce and Labor, U. S. Senator Wm. P. Frye, and Hon. T. E. Burton, Chairman of the Committee of Rivers and Harbors of the House of Representatives. Other specially prepared articles by authorities on marine subjects are given, and there are published plans of a new revenue cutter and the engines of the new battleships *Mississippi* and *Idaho*. The number is handsomely illustrated, making it in all an issue reflecting credit on its new publisher, the Penton Publishing Company, Cleveland, Ohio.

THE USE OF SUPERHEATED STEAM.*

BY PROF. STORM BULL.

Anybody who has followed the development of the steam engine during the last few years, cannot help having noticed the increased use of superheated steam, especially in European practice. All new steam plants of any considerable size, and even many smaller ones, on the continent of Europe are now using superheated steam; and in the last couple of years a number of plants utilizing superheated steam have been built in this country. It cannot be doubted, however, that the United States has been behind Europe in this respect and that it is high time that we try our very best to at least equal our competitors in this branch of mechanical engineering. Because of the comparative newness of the subject it is very possible that a great many American engineers do not realize its importance and it is, to a certain extent at least, the purpose of this paper to try to convince the skeptical ones that it is necessary to use superheated steam in order to attain the highest commercial efficiency of the steam plant—not of the steam engine alone—but of both engine and boiler combined. To avoid misunderstanding it is perhaps necessary to state at this place that this does not apply alone to the ordinary reciprocating steam engine, but also to at least the same degree to the steam turbine.

Probably most of you know that the use of superheated steam is not new, on the contrary, it is probably not far from 75 years old. The old masters in steam engineering, without doubt, realized the fact that the principal loss of efficiency in the steam engine was due to the condensation of steam in the cylinders, and, as is well known, they tried a great many means to reduce it and with varying degrees of success. There is no question in the minds of all competent authorities that the best means of reducing the condensation is in the use of highly superheated steam, and this has been known for a great many years. It almost seems that the "grand old man" James Watt anticipated or at least had a presentiment of nearly all the improvements in the steam engine which were to be introduced into its design during the last century. However, it seems that he had no knowledge of superheated steam or of its advantages, which seems very natural, as he really was the first one who had an adequate and thorough knowledge of saturated steam. The first mention of the practical use of superheated steam, which I have been able to discover, is found in the "Life of Richard Trevethick" of the Binner-Downs Mine in Cornwall, England. In this book it is stated that a certain Captain McGregor in 1828, in order to compete with a record established by an engine of a neighboring mine, whose cylinders had been insulated with sawdust, built a jacket of brick around the cylinder and the steam pipe, with an air space between the brick work and the iron and that he built a fire in this open space, by which means he increased the duty of his engine from 41,000,000 to 63,000,000 foot-pounds per bushel (86 pounds) of coal. Trevethick himself tested the 70-inch cylinder engine with steam at 48 pounds pressure and which made 8 strokes per minute, and he found that by using 5 bushels of coal in 24 hours under the cylinder, he reduced the

*Paper read November 4, 1903, before the Western Society of Engineers.

consumption of coal by the boiler from 108 to 67 bushels for the same work, showing a saving of more than 25 per cent. That such a saving must necessarily have aroused attention is evident; but it has been impossible for me to find any trace of it in the published records. In 1834 John Ericsson made some experiments with superheated steam, but no record of these experiments has been found. The next record that I have been able to find is that in 1845 Mr. Longridge made several experiments with superheated steam at low pressure, and in 1851, he was followed by Rafford in France who took out patents for a superheating plant.

From this time on, and lasting, perhaps, for 20 years, the interest in superheated steam was very active. Among the many engineers and scientists who contributed to the progress in this line, should be mentioned especially Hirn, Isherwood and Faraday. The first named made a great many experiments in 1857, using steam of 55 pressure and temperatures ranging from 410 to 490 degrees Fahrenheit. The results of his accurate experiments showed an increase in the economy of the whole plant of from 20 to 27 per cent.

During the fifties and sixties, however, the principal use of superheated steam was found in the marine engine, and in the literature of the subject quite a number of tests of steamships with and without the use of superheated steam may be found. Penn showed an increase of economy of 20 per cent. for the steamer *Valletta,* with a steam pressure of 20 pounds. The Parson and Pilgrim's superheater was especially designed for marine practice. It consisted of a number of semicircular pipes placed in the furnace, by which means it is stated that a saving of one-third in fuel was realized. The English Board of Trade, however, objected to the use of superheated steam on the ground that the high temperatures used were liable to break the steam up into its elements, thereby making it unnecessarily dangerous. Fortunately, Professor Faraday, who fully investigated the matter, was able to convince the authorities that this objection was unfounded. The tests of marine engines made at about the same time, during the latter part of the fifties, show gains in economy of from 20 to 30 per cent., always depending upon the amount of superheat which was available.

Our own Isherwood was at first very skeptical as to the practical use of superheated steam. He at first declared against it on the ground of injury to the cylinder, difficulty of lubrication, extra weight and short life on board of ship. Later on, however, he recommends the use of superheated steam because of the gain in economy of 30 per cent. shown by his experiments, but suggests that the limit of superheat be placed at 100 degrees Fahrenheit, on account of the difficulties of lubrication. In 1863-1864, he made extensive tests on the steamer *Eutaw,* which had a single cylinder inclined engine with poppet valves and a Stevens' adjustable cut-off. The best results of these tests show a gain in steam economy of 18 per cent. and 15 per cent. in coal consumption.

During the years from 1850 to 1870 a great many superheaters were installed, especially on shipboard, notwithstanding the fact that engineers always found great difficulties with respect to the lubrication and that the material of the superheaters did not withstand the action of the heat for a very long time. That there was trouble with the lubrication should not surprise anyone when it is remembered that none of our present day mineral oils were known at the time, and that the only available lubricating materials were animal oils and fats. The steam pressure used up to that time did not exceed 50 pounds, at least not on ship-board, and for such a pressure the animal oils or tallow answered very well, even if the steam was superheated perhaps 100 degrees Fahrenheit. But the latter part of the sixties saw the introduction of the compound engine with its accompanying higher pressure, and this proved to be a very effective damper to the use of superheated steam—and for two reasons. The first one was the very much greater economy of the compound engine as compared with the single expansion engine using steam of lower pressure, and because of this increased economy a saving of both space and weight, a very important factor in a ship. The second reason was that the difficulties in the way of proper lubrication of the cylinders became so great that it was found necessary to reduce the superheat to such an extent that the gain from it in economy became almost imaginary and which certainly did not warrant the expense of the installation of the superheater. The universal use of the compound engine on shipboard, therefore, very soon made the use of superheated steam impossible on steamships. It had been much less used in stationary practice, but with the gradually increasing pressure it also disappeared here. It is true enough that the use of mineral oils very soon after this time became general, but our present day heavy lubricating cylinder oils were not known then, and, in addition, and this is much more important, the attention of all the foremost engineers of the world, working in this line, were now exclusively directed towards the improvement of the economy of the steam engine by means of the use of higher pressure and of the compound principle; they lost sight of the superheated steam, presumably, because of the many bad reports regarding its use.

You all are aware of the fact that the improvement of the economy of the steam engine during the last thirty years of the last century was all due to the increasingly higher steam pressure and to the introduction of the compound and multiple expansion engines, if exception be made concerning the greatly improved mechanical details, especially with respect to valve gear and governor. But towards the end of the last century nearly all competent engineers agreed that the improvement due to the causes just mentioned had about reached its limit. The increased cost of making more than a triple or quadruple engine was not warranted by the very slight increase in economy due to an additional cylinder—at least with the high steam pressure then practicable. Because of the available material it had been impracticable—perhaps unprofitable—to design boilers for a higher pressure than, say, 250 pounds. It is due to this fact that the attention of the engineering world has within the last half dozen years increasingly been directed to the use of superheated steam as a means of improving the still lamentably low economy of the steam engine, and it is my opinion that the history of these years has conclusively shown that for the present, at least, the outlook in this direction is very

much brighter than in any other. I realize very fully that Professor Lewicky, of the Polytechnic School of Dresden, Saxony, is perfectly correct when he states that all that is necessary in order to get a theoretical efficiency of the steam engine of 80 per cent. is for the practical engineers of the world to supply material from which cylinders and boilers could be made which could properly resist pressures corresponding to a temperature of something like 1800 degrees Fahrenheit and also such temperatures. Unfortunately, there is at present no prospect that such a material will be supplied, at least in the near future, and, in fact, as stated above, the limit as to pressure has just about been reached for the present, and it is but natural that engineers should be looking out for other means of improving the economy of the steam engine which is still our greatest source of motive power.

During all the years when it seemed that all interest in superheated steam had died out, there were still a few firm adherents working in this line. Among them must be specially mentioned Hirn, in Mulhouse, Alsace, his successor Schwoerer, and William Schmidt, in Germany. More than to any other it is due to these persons that at the present time superheaters have become a practical success. Schwoerer originated the ribbed cast iron superheater used extensively at the present time, whereas Schmidt used wrought iron coils and he was the first to use in practice highly superheated steam, the superheat often being more than 200 degrees Fahrenhit. Some of you will no doubt remember the sensation that was created when some eight years ago the results of a series of tests of a boiler and engine built especially for superheated steam by William Schmidt were reported in the technical papers. The tests had been conducted by Professor Schroeter of Munich, probably the highest authority in this branch in Germany, so that the results could not be doubted. Although the engine was quite a small one, yet it was shown that the consumption of steam had been only about 10.4 pounds per indicated horse power per hour, when using superheated steam; whereas the consumption of steam per brake horse power hour was only about 12.3 pounds, the engine developing 75 horse power. The statement of the consumption by an engine of a certain number of pounds of superheated steam per horse power per hour does not give the means for a true comparison of the performance of this engine with one using saturated steam. It is much more equitable to base the comparison on the consumption of coal or the number of heat units converted into work. In the test spoken of it was shown that the amount of coal used per indicated horse power per hour was only about 1.3 pounds, certainly an extraordinary result for an engine of only 75 horse power. The engine in question was a tandem compound, both cylinders being single acting; throughout of very original design and built especially for the use of highly superheated steam. The boiler which was also built and designed by Mr. Schmidt, was also very original and has since proved to be excellent in every way. As a result of this first test, Mr. Schmidt's engines became very popular and at the present time several hundred are running in Germany and adjacent countries.

As is well known there are two essentially different arrangements of the superheater with respect to the boiler. The most common is to install a coil in the boiler setting proper, through which the saturated steam taken from the top of the boiler is drawn on its way to the steam engine. If a high degree of superheat is wanted, the coils must be installed in such a way that the hot gases will strike them long before they have been cooled sufficiently to allow them to escape into the chimney. This arrangement has, as is well known, been extensively employed by the Babcock & Wilcox Company. On the other hand, if only a slight superheat is desired the coils may be placed so that the gases on their way from the boiler to the chimney will surround the coils. It may, however, be stated at this place that this last arrangement is usually not satisfactory, as the degree of superheat is so small that the gain in economy of the steam engine frequently does not warrant the installation of the superheater.

The second arrangement is to install an independent superheater with separate furnace, and a great many installations of this kind are found at present, especially on the continent of Europe. Many competent engineers have expressed their doubts as to the possibility of a gain in economy due to such installations, but repeated test of a number of such plants have conclusively shown that these doubts were not warranted by the facts. When properly designed and run, such installations have invariably shown an economy as compared with the ordinary boiler and engine arranged for saturated steam.

Both wrought iron or steel, and cast iron are at the present time being used for superheaters. Because of the high temperature to which the material of the superheater will be raised, it is impracticable to have ordinary flange joints or couplings exposed to the hot gases. If therefore the superheater consists of a series of steel pipes of small diameter, they must be bent into coils, something like the ammonia pipes in a refrigerating machine. If, on the other hand, the superheater is built of cast iron it is usually built along the lines in which Schwoerer originally made them; a number of large, straight cast iron pipes connected by flanged return bends, the flanges being placed in such a manner that they cannot be reached by the hot gases, these pipes being also provided with a large number of external ribs so as to increase the heating surface. It is probable that the latter type will suffer less than the former type because of the action of the heat, both because its material is cast iron and because the walls of the pipes are quite heavy; but on the other hand, the heating surface in the former type will be much more effective—both because of the fact that the walls of the pipes are so thin and because the steam to be superheated is here distributed in a large number of small pipes, so that all steam is much closer to the hot gases from which the superheat is to be derived. The difficulties which were encountered years ago with respect to the wearing out of the superheaters have now been overcome, as can be readily seen from the fact that there are now in service superheaters which have been used continuously for eight years and without any important repairs. The number of plants now running in continental Europe is several thousand, of which several hundred are more than four years old, and any one familiar with the periodical technical literature, of Germany in particular, will

agree with me that the published records of these plants so far as they can be found all testify to the fact above stated that the criticism, so often heard in former years that superheaters deteriorated very rapidly, is not true at the present time.

It was also to be expected that the use of such high temperatures in the engine cylinder would create new difficulties, not alone with reference to the proper lubrication of the same, but also and perhaps still more so, with regard to the great expansion of the parts of the cylinder itself. But it can also be stated positively that all these difficulties have been overcome. Just as in the gas engine where the temperatures are very much higher, and where these difficulties have been overcome by the proper design of the cylinder, so in the steam engine our modrn engineers have found the proper way to proportion the various parts of the cylinder in such a manner that the expansion due to the high temperature does neither produce breaks in the casting nor leaks at the stuffing boxes. With reference to the lubrication it is only necessary to remind you of the existence of our modern heavy lubricating oils which made our modern gas engines possible. However these difficulties also explain the fact that William Schmidt previously mentioned, and who is more than anybody else entitled to the credit of the progress in the use of superheated steam during these late years, designed his first engines for superheated steam as single acting, probably in imitation of the only successful gas engine then existing, in which both the proper lubrication of the cylinder and the taking care of the expansion of the same had been satisfactorily accomplished. But at the present time, eight years since Schmidt first achieved success, we have both double acting gas engines and steam engines, using highly superheated steam, and when properly designed and looked after, they run satisfactorily. What is more, in my mind at least, both the double acting gas engine and especially the double acting engine for superheated steam, will be the type of the future, if recent progress in these lines is to be any criterion for what is going to follow.

The latest steam engine designed for superheated steam does not look very different to the uninformed from an engine using saturated steam of very high pressure, although a good many details may be different. In this connection it might be mentioned that the conclusive evidence of the experience of recent years is that Corliss valves are not adapted for the use of highly superheated steam and that consequently, we in our country, will have to modify the design of our most economical engines in a very essential part before we can use with profit, steam superheated to a degree which will show an improvement in economy to such a degree that it will warrant its use. As was intimated before, it is not alone the reciprocating steam engine proper which benefits from the introduction of superheated steam. The steam turbine, so far as the experience goes at present, is destined, it seems, to improve its economy to a higher degree even than the reciprocating engine. Experiments seem to show it, and the reasons for it advanced by the various investigators seem perfectly plausible. In what follows I propose to present to you some of the principal tests of engines using superheated steam and conducted by competent authorities, as well as the results of my limited experience in this direction.

The principal results of the test of Professor Schroeter of the Schmidt engine and boiler in 1895 and mentioned before, were as follows:

Size of engine—12 1-4 in. x 27 3-16 in. x 19 1-2 in.; vertical, tandem, compound, making—

	1st test.	2d test.
Pressure	156.2	159.0
Brake horse power	61.72	62.18
Superheat, degrees Fahrenheit	235.0	281.0
Steam in lbs., per I. H. P., per hour	10.91	10.19
Steam in lbs., per brake H. P., per hour	12.61	12.34
Coal in lbs., per I. H. P., per hour	1.36	1.26
Coal in lbs., per brake H. P., per hour	1.57	1.52
Per cent. of heat acounted for in saturated steam	65.0	63.7
Per cent. of heat in the superheat	6.9	8.2
Per cent. of heat given to feed water	6.9	6.6
	78.38	78.5

Schroeter also reports on a similar engine, a little larger however, of 90 horse power, using superheated steam, which engine used only 9.95 pounds of steam per horse power per hour and 1.43 pounds of coal, certainly a very remarkable result for such a small engine.

In 1896 Professor Ripper, of England, published the result of a series of tests of a small Schmidt engine using superheated steam. The size of the engine was 7 1-16 by 11 3-4 inches, it made 180 revolutions per minute. He used both saturated steam and steam of different degrees of superheat in order to show the influence of the same.

	1.	2.	3.	4.	5.	6.
Steam pressure, lbs., absolute	87.5	79.9	86.1	87.6	118.4	116.0
Temperature of steam, deg. F.	329.0	412.0	590.0	667.0	612.0	653.0
Degrees of superheat, F.	0.0	88.0	261.0	338.0	263.0	306.0
Indicated horse power	16.55	16.32	16.43	16.59	17.73	17.60
Lbs. of steam per hour per I. H. P.	39.33	34.66	21.48	19.13	18.84	17.58

It will be apparent from this table how rapidly the consumption of steam decreases with the increase of the superheat. With 338 degrees of superheat the number of pounds of steam used is not quite one-half of that used for saturated steam. In itself this performance of a single expansion, non-condensing engine, indicating only some 18 horse power and using less than 20 pounds of steam per horse power per hour is very startling.

In 1895 a large, triple expansion engine for superheated steam was installed in Augsburg, Bavaria. The old boilers were to be used and these could not carry more than 85 pounds pressure; but in connection with these Schwoerer superheaters were installed. Professor Schroeter conducted some very exhaustive tests on this plant, using both superheated and saturated steam in order to find out whether the moderately superheated steam showed any gain.

The dimensions of the engine and the main results of the tests are as follows:

Cylinder diameters, 27 1-2, 43 3-8, 45 3-8, 45 3-8.

Stroke, 63 in. Revolutions per minute, 60.

	1.	2.	3.	4.	5.	6.
I. H. P.	1180.5	1167.3	1127.8	1200.8	976.9	993.1
Steam pressure (gauge)	84.34	83.35	84.21	84.77	83.35	83.92
Temperature, deg. F.	414.7	418.1	420.1	327.1	326.1	326.5
Degree of superheat	87.9	92.0	92.3	.....	.....	.....
Steam per H. P. per hour	13.06	12.68	12.05	14.31	13.55	13.22

Although the degree of superheat here is very moderate and the steam pressure very low, yet a decided gain in economy is shown.

A small Schmidt steam engine and boiler installed at Ascherleben, Germany, was also tested by Professor Schroeter. The cylinder had a diameter of 9 7-8 inches and a stroke of 15 3-4 inches and was single acting; it made 150 revolutions per minute. A series of tests were made to show the influence of the cut-off and of various degrees of superheat. The most important results were as follows:

	1st test.	2d test.
Indicated horse power	297.1	326.1
Steam pressure, in pounds (gauge)	99.4	101.8
Temperature of steam, degrees Fahrenheit	337.1	495.0
Superheat, degrees Fahrenheit	0.0	156.0
Pounds of steam per I. H. P., per hour	14.1	11.9
Heat units per I. H. P., per hour	286.0	257.0
Percentage of heat units contained in steam given to walls of high pressure cylinder during admission period	11.84	3.37
Percentage of heat units contained in steam given to walls of low pressure cylinder during admission period	27.3	21.6

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Cut-off, per cent	16.1	22.9	35.0	41.1	48.0	22.5	15.7	23.4	36.5	26.1	24.3
2. Steam pressure, by gauge	120.0	115.7	111.4	98.7	95.8	113.6	115.6	115.0	105.1	90.9	98.7
3. Temperature, degrees Fahrenheit	669.0	671.0	673.0	680.0	689.0	667.0	574.0	588.0	597.0	491.0	408.0
4. Superheat, degrees Fahrenheit	319.0	324.0	328.0	343.0	354.0	321.0	227.0	241.0	206.0	160.0	71.0
5. Consumption of steam per horse power per hour	17.85	17.59	18.03	17.54	18.03	17.45	18.86	18.52	18.93	23.08	27.68

The results conclusively show that the cut-off has very much less influence on the economy of the steam engine when running with superheated steam than with saturated, because there is very little change in economy between a cut-off of 16 per cent. and one of 48 per cent., whereas it is probable that if the engine had been running with saturated steam this difference would probably have been at least 25 per cent. It is also well known that the interchange of heat between the steam and the cylinder walls is very rapidly reduced with increased superheat, so that, for instance, the heat absorbed by the walls during the admission period is almost zero when the steam is superheated from three to four hundred degrees. From some tests to be quoted later this will be very plain. But in passing it is perhaps worth while to call attention to the fact that the gain in economy due to the use of superheated steam is not alone due to the greatly reduced condensation in the cylinder, a fact which everybody recognizes, but also and perhaps in just as high a degree, to the greatly reduced interchange of heat between the walls of the cylinder and the steam while it is in the superheated state, this being due to the absence of water, which is always adhering to the walls when saturated steam is being used.

From a number of carefully conducted tests it has been shown that the steam at the end of the expansion in the high pressure cylinder of a compound engine is still slightly superheated, if the superheat to begin with is from 200 to 300 degrees Fahrenheit. This is especially true if the cylinder is jacketed with superheated steam, and under such circumstances it would almost seem that it should be possible to eliminate all condensation from the high pressure cylinder, and at least reduce the heat interchange to such an extent that it hardly needs to be considered. In a single expansion cylinder or engine this would not be true, at least with the degree of superheat which is being used at present, as necessarily the change in temperature of the steam here would be very much greater. To prove these statements I submit the results of two sets of tests made by Professor R. Doerfel; one for a compound and one for a triple expansion engine.

Compound engine at Haunsdorf, Germany.

Triple expansion engine at Zwoden, Bohemia.

	1st test.	2d test.	3d test.	4th test.
Indicated horse power	801.8	793.9	654.0	612.5
Steam gauge pressure, in pounds	Average, 138.5			
Temperature of steam, deg. Fahrenheit	495.5	496.0	512.8	499.5
Superheat, deg. Fahrenheit	135.9	137.0	153.2	140.1
Pounds of steam per I. H. P., per hour	11.07	10.95	10.75	10.95
B. T. U. per I. H. P. per hour (degree)	237.8	235.5	232.8	236.1
Percentage of heat contained in steam given to wall of high pressure cylinder during admission period	2.07	1.75	3.3	4.73

In the case of the compound engine, the direct comparison between superheated and saturated steam is made, and as will be seen the amount of heat given to the walls of the cylinder during the admission period is reduced to about one-fourth of what it is for saturated steam. For the triple expansion engine, it will be seen that the loss of heat is so small that it hardly needs to be taken into account in practical engineering. It should also be remembered that in both cases the degree of superheat is comparatively low, and that still better results can be expected and are in fact realized with a higher degree of superheat.

That the consumption of steam in both cases is very low should also be noticed, in fact a great deal lower than can be realized when saturated steam is used, but obviously if the degree of superheat had been greater, still better results would have been obtained.

In studying the files of the technical periodical literature of continental Euorpe for the last few years, one finds the records of a very large number of tests of plants using superheated steam, and all the records so far as I have seen them point in the same direction.

New Ferryboats for the Jersey Central Railroad.—The Central Railroad of New Jersey has awarded the contract for two steel double decked ferryboats to the Harlan & Hollingsworth Company, Wilmington, Del., These boats, designed by Wintringham & Wells, naval architects, 32 Broadway, New York, N. Y., are practically duplicates of the four new boats recently built for the Jersey Central and are to be run in the new Twenty-third street service.

Old Steamer Massachusetts Broken Up.

It is indeed a sad sight to see a vessel which for years has done good service and become what might be called a "landmark" in certain waters, laid up as unfit for service and to be eventually broken up.

One of the most familiar vessels on the waters of New York harbor has been the side-wheel steamer *Massachusetts,* which since the year 1877 has, with but few and brief interruptions, passed daily in or out of this harbor. The above view, which is reproduced by courtesy of the *Boston Globe,* show the final resting place of this old steamer as she lay broadside on the

THE OLD LONG ISLAND SOUND STEAMER MASSACHUSETTS BEACHED AT APPLE ISLAND, R. I., FOR BREAKING UP.

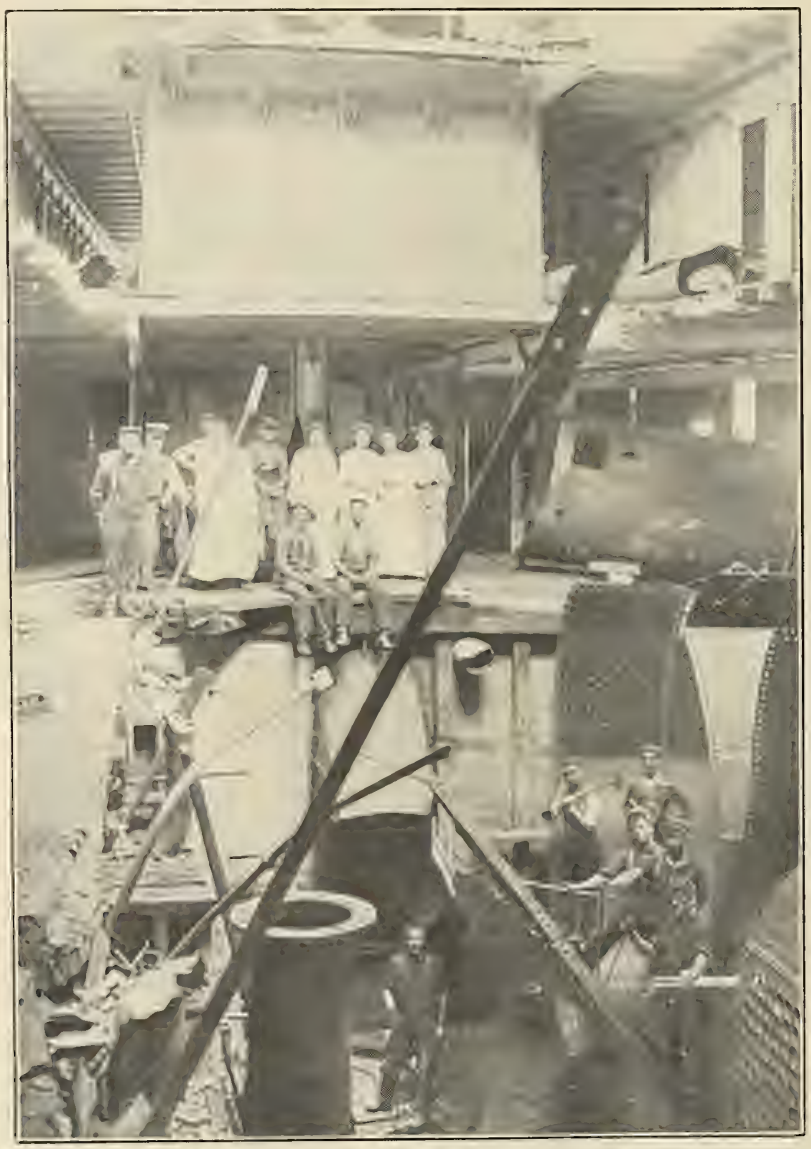
MARINE ENGINEERING DATA CARD. **APRIL, 1904.**

NAME—Massachusetts. NATIONALITY—American. TYPE—Paddle wheel sound steamer.

LAUNCHED—1877. BUILDER—H. Steers. OWNER—N. Y., N. H. and H. R. R.

Construction, material	wood
Length over all	340 ft. 0 ins.
" between perps	324 " 0 "
Beam over guards	76 " 0 "
" molded	46 " 0 "
Depth of hold	16 " 4 "
Mean draft, light	10 " 0 "
" " loaded	11 " 4 "
Displacement	3,000 short tons
Tonnage, gross	2,607
" net	2,171.1
Cargo capacity in cars	55
Coal bunker capacity	120 tons
Maximum speed	16 1-2 miles
Engines, type of	Beam
Cylinder diameter	90 ins.
Stroke	14 ft.
Rev. designed	18
I. H. P.	2,800
Cooling surface in condenser	5,753
Wheels, type	paddle, radial step bucket
" diameter of paddle	38 ft. 11 ins.
" width of paddle	6 ft.
" depth " "	28 ins.
Boilers, number of main	2 steel, 4 iron
Type	Scotch
Diameter	12 ft. 8 ins.
Length	two 12 ft. 6 ins.; two 13 ft. 2 ins.; two 11 ft. 6 ins.
Working pressure on main	35 lbs.
Furnaces, 18 plain, diameter	40 ins.
G. S.	466 sq. ft.
H. S. main boilers	7,923 " "
Coal consumption per hour (approx.)	4.7 tons

beach at Apple island. For many days a gang of workmen were employed in dismantling and breaking up the machinery for scrap. Some of the auxiliaries were in sufficiently good condition to be used again, and all of the iron and interior fittings of any value were removed. Then it was that a fire was started in several parts of the old hull and an immense bonfire made of this old ship—a much more fitting end than that which comes to most craft, which after being dismantled are fitted up for barges.



THE WRECKERS AT WORK ON THE MASSACHUSETTS TAKING OUT THE METAL PREVIOUS TO BURNING HER.

The *Massachusetts* was a favorite boat in her day. She was built of wood at the yard of Henry Steers, Greenport, L. I., and the joinery was designed and installed by William Rowland, while the machinery was made by John Roach and Son. She was launched in 1876, and in May of the following year established with her running mate, the *Rhode Island*—which was afterward lost—the Providence line to Boston, between New York and Providence, connection at the latter port being made by rail to Boston. These boats were owned and operated by the Providence and Stonington Steamship Company.

On the night of October 4 the same year, during a heavy gale, she went ashore at Rocky Point and there continued for several hours, and when the let-up came there were four holes in the bottom and it was feared that she would be a total loss. The Coast Wrecking Company undertook to salve the ship, two weeks afterward succeeded in floating her and towed her to New York, where she was dry-docked and repaired, the damages amounting to over $70,000.

From that date on the *Massachusetts* proved to be a fortunate ship, for she had, comparatively speaking, but few accidents during the 28 years of service. When she came out she was fitted with arc electric lights in her main saloon, which is stated to be the first install-

ment on board ship of an electric-lighting plant. In 1885 the lights were replaced by the Brush incandescent system. The dimensions of this old boat are presented in the table on page 175.

She was fitted for carrying 628 passengers and had 184 state rooms in all. The feature of this boat was that the dining room was on the main deck aft. On former sound boats this room was placed on the lower deck, but since her day the new boats have adopted this arrangement. The engines were of the usual walking-beam type, designed for a working pressure of 35 pounds and to run at 18 revolutions, and indicated 2,800 horse power. This power drove the vessel at a speed of a little over 16 miles average. The side wheels were of the radial-step bucket type, 38 feet 11 inches in diameter.

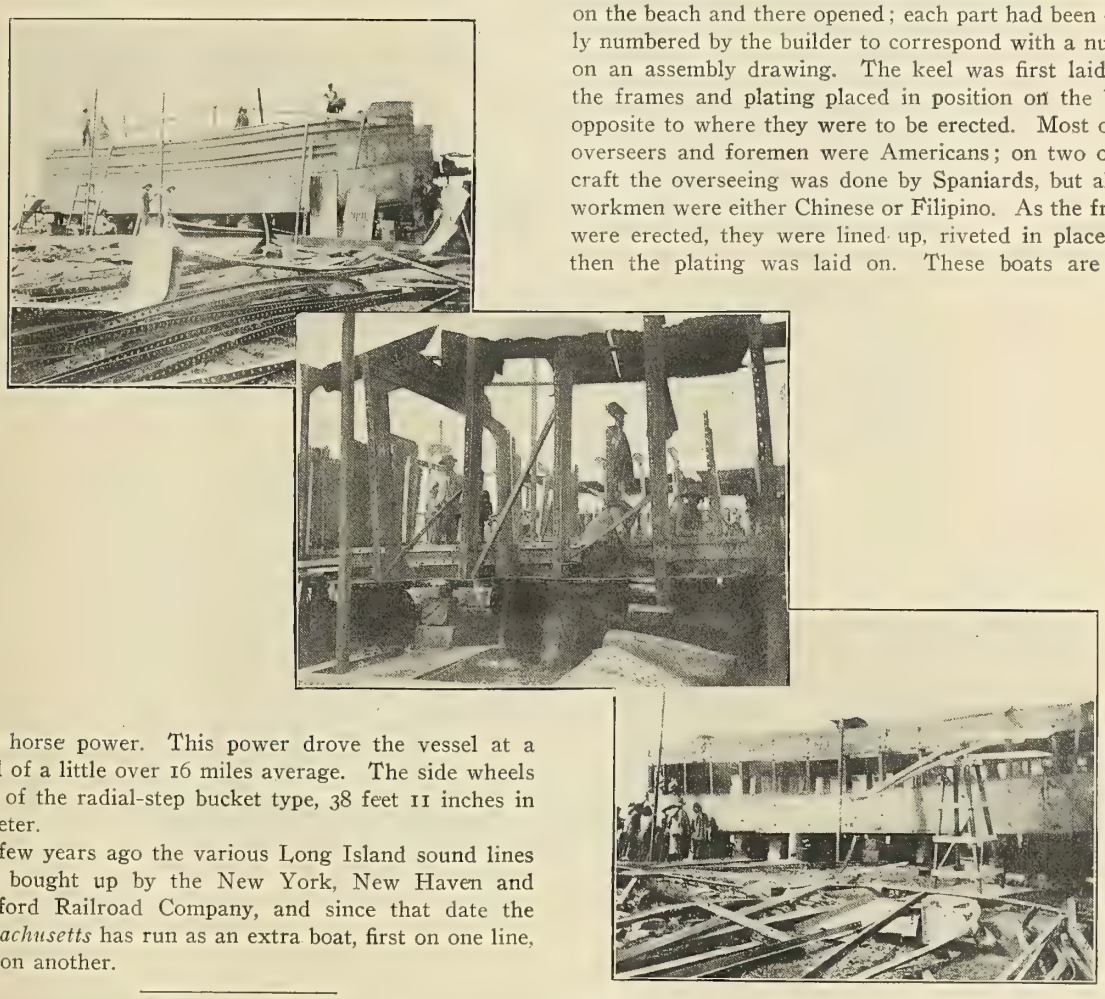
A few years ago the various Long Island sound lines were bought up by the New York, New Haven and Hartford Railroad Company, and since that date the *Massachusetts* has run as an extra boat, first on one line, then on another.

Revenue Cutter in Baltimore Fire.—The United States Revenue Cutter *Windham* did gallant service along the water front of Baltimore during the tremendous fire of February 8 and 9. The *Windham* took up a position near a large lumber yard, which was threatened by the approaching flames. The steamer, which was at all times in dense smoke and flying cinders, brought into play all of her fire apparatus, and kept the flames from spreading to the lumber. After the fire was extinguished, the officers and crew of the *Windham* were assigned to patrol duty on the harbor. The *Windham* was in charge of Capt. S. E. McGuire, and the other officers were Lieutenants Ridgely and Wheeler, Assistant Engineer Bryan and Cadet Crapster.

New Boats in the Philippines.

Several new steel craft have recently been placed in commission in the Philippine islands for use in the quartermaster's department of the United States army. These boats were built in the United States, then taken apart and shipped in crates to Manila, where they were erected.

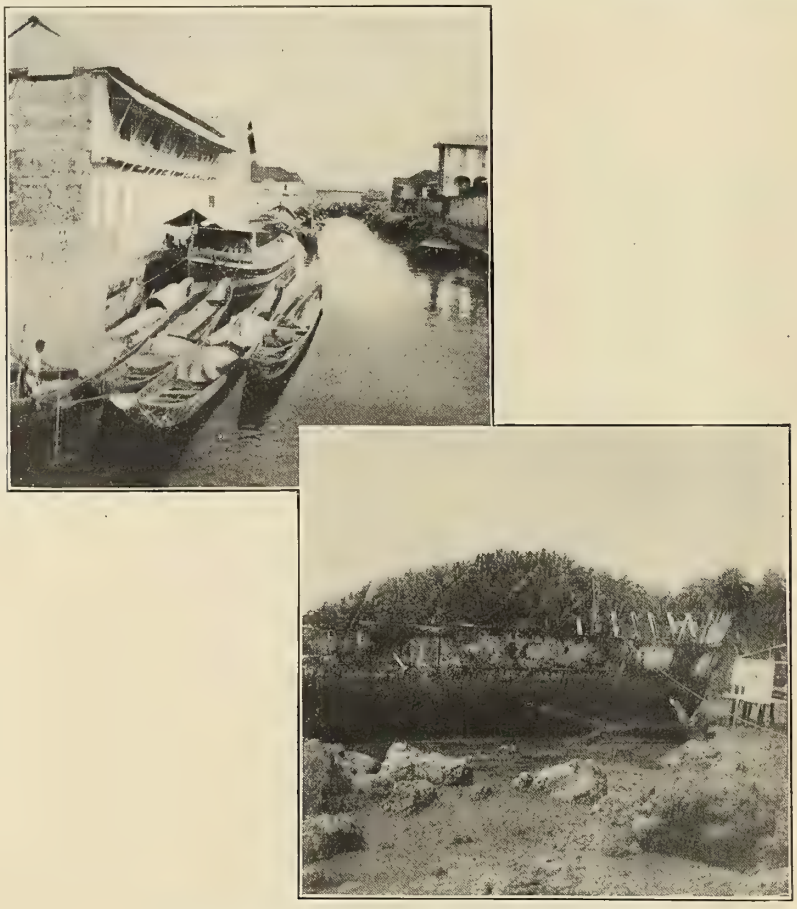
I passed the yard daily and was much interested in watching them grow. In fact, I met several Spanish marine agents and others watching with much interest the progress of building, as they were considering placing orders with the American concern for similar boats. The crates containing the material were placed on the beach and there opened; each part had been clearly numbered by the builder to correspond with a number on an assembly drawing. The keel was first laid, and the frames and plating placed in position on the beach opposite to where they were to be erected. Most of the overseers and foremen were Americans; on two of the craft the overseeing was done by Spaniards, but all the workmen were either Chinese or Filipino. As the frames were erected, they were lined up, riveted in place, and then the plating was laid on. These boats are constructed with several water-tight compartments, so that if the shell in any one were punctured, there is sufficient buoyancy in the remaining holds to float the boat.



VIEWS TAKEN DURING THE ERECTION OF AMERICAN BUILD STEEL BARGES AT MANILA.

Right alongside these steel boats the natives were erecting small steam and sailing craft of wood, and a comparison of the two methods and speed of construction was very interesting. The iron boats are put up rapidly, as compared with the progress on a native boat of the same size. Some of the old fashion wood craft require several months in building. The keel is usually a great log properly hollowed out, and this takes many months of chipping, gouging, and scraping, and then

the frames are adjusted and the side planks put on. Very few iron boats are used; in fact, in some craft no metal work is used at all, strong hardwood pins taking the place of the bolts. These pins are driven securely through the timber work, and made water-tight by native gum. The planking is calked, as usual. The native boats are very poor sea boats, as I know from several unfortunate experiences in traveling in them. While I was crossing Lake Lanoa, a slight wind blowing, the boat itself sank two feet below the surface, but was held there by the outriggers. We stood upright in the boat while the natives continued paddling across as best they could with the boat under the water and the bamboo outriggers supporting the whole affair.



NATIVE CRAFT AT MANILA. AN ABANDONED NATIVE BARGE.

The metal boats will no doubt prove an innovation to this part of the world and will give good service in lightering cargoes from the ships in the harbor to the cities and towns along the shoal water-fronts. I believe that other islands would be quick in adopting this form of boat.

Ex-Soldier.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 40 vessels of 15,208 gross tons built in the United States and officially numbered during the month of February, 1904. The largest steel steam vessel included in these figures was the *Edwin F. Holmes,* built at Loraine, O., by the American Shipbuilding Company, and of 4,787 gross tons.

Shipbuilding Bounties as Applied in Japan and Abroad.

A paper of this title was presented by Mr. K. Uchida, director of the Marine Bureau, Department of Communications of Japan, at the Osaka meeting last summer of the Japanese Society of Naval Architects, which strikingly illustrates what can be done in building up a merchant marine under government subsidy.

The first part of the paper mentions the subsidy of other countries, and then gives the history of the early development of the Japanese mercantile marine. In 1867 the number of ships on the Japanese register was 46 of 17,000 gross tons, while at the outbreak of the China-Japan war in 1894, the number had grown to 140 vessels with a total tonnage of 210,000, and during that year 67 vessels of 100 tons and upwards and aggregating 102,300 gross tons, were added to the register. Of these 67 only 29 of 6,300 tons were built at home. At this time Japan owned but one ship of over 1,000 tons, and that a wooden one.

In 1896 the government of Japan resolved to encourage both the shipping and the shipbuilding of the country and legislation was enacted to remain in force for eighteen years. This act provides for Japanese-built ships as follows: Those between 700 and 1,000 tons to receive a bounty of 12 yen* per ton; those above 1000 tons, 20 yen per ton. An additional sum is paid upon

* A yen is about equal to one dollar.

the machinery of vessels of 700 tons and over at the rate of 5 yen per indicated horse power developed on trial, regardless of the size of the engine. There have been built, or are now under construction, 41 ships, which have taken or will take advantage of the act, the total tonnage aggregating nearly 100,000 gross tons.

In addition to this subsidy to ship builders, Japan has paid a handsome subsidy to the steamship lines, and, while of late years this amount has been reduced, the Government has entered into a special contract with first-class steamship companies which operate the regular lines. The contracts now in force are with the Nippon Yusen Kaisha, the Toyo Kisen Kaisha, the Osaka Shosen Kaisha, the Daito Kisen Kaisha, H. Oie & Company, and the Hunan Steamship Company. The first-named company operates the following lines:

1. Yokohama to Melbourne, employing three steamers of 3,500 tons and above; speed, 16 knots and above. A monthly service. Subsidy, $270,000. Contract runs from April, 1901, to March, 1906.

2. Yokohama to Bombay, employing three steamers of 3,000 tons and above, 10 knots and above. A monthly service. Subsidy, $90,000. Contract runs from April, 1901, to March, 1906. 3. European Line, employing twelve steamers of 6,000 tons and above; 14 knots and above. A fortnightly service. Subsidy, $1,360,000. Contract runs from January, 1900, to December, 1909. 4. Hong Kong to Seattle, employing three steamers of 6,000 tons and above; 15 knots and above. A four weeks' service. Subsidy, $330,000. Contract runs from November, 1901, to December, 1909.

Besides these, this company carries the mails from Yokohama to Shanghai, from Kobe to Korea and North China, Kobe to Vladivostock, Kobe to Otaru, and Aomori to Mororan.

The Toyo Kisen Kaisha has the following route and subsidy:

Hong Kong to San Francisco, employing three vessels of 6,000 tons and above, and 17 knots and above. A four weeks' service. Subsidy, $517,000. Contract runs from January, 1900, to December, 1909.

The Osaka Shosen Kaisha has the following:

1. Shanghai to Hankow, employing three steamers of 2,000 tons and above; 11 knots and above. A bi-weekly service; in winter, three times a fortnight. Subsidy, $125,000. Contract runs from January, 1898, to December, 1907. 2. Hankow to Ichang, employing two vessels of 1,500 tons and above; 10 knots and above. Service, six times a month; in winter four times. Subsidy, $56,000. Contract runs from January, 1899, to December, 1907. 3. Kobe to Korea, employing two steamers of 700 tons and above; 10 knots and above. A three weeks' service. Subsidy, $15,500. Contract runs from October, 1900, to September, 1905.

The first two of the other companies mentioned run services on Chinese rivers and on the Japanese sea, respectively, and receive subsidies, the one of $29,550, the other of $70,000.

The total annual payments on account of the special services above detailed amount to $3,000,000.

Progress in England of the Marine Steam Turbine.

The development of the steam turbine for marine purposes continues to occupy very considerable attention and no doubt is now entertained as to the future. Twelve ships are now being constructed for turbine engine propulsion and several firms have now secured the license from Messrs. Parsons for the manufacture so that with competition there is likely to be a material reduction in the cost. In addition to the two Clyde steamers, a third for Calais and Dover service, a fourth for the Newhaven and Dieppe run, there has just been floated a fifth merchant steamer for the service between the nearest land points separating Britain and Ireland, *i. e.,* between Stranraer and Larne. There will be launched within the next two or three months two boats for the Midland Railway Company, also for the Irish service, and one for service between Australia and New Zealand. In these instances the difference in price is inconsiderable and it would seem as if in the future the turbine would have the advantage. In addition to the two Allan liners for the Atlantic service, a third Atlantic liner has now been ordered for the Cunard Company. This is a vessel of 16 or 17 knots speed, a duplicate of ship with reciprocating engines now building for the Cunards, and must not be confused with the proposed high speed leviathans.

The question of fitting the turbine to these two high speed subsidised mail liners for the Cunard Line has not yet been settled, but in view of the progress made by the committee appointed by the company to report on the subject, there is every prospect that the vessels will be laid down by May or June at the latest, and all the indications point to the adoption of the Parsons turbine system, working four shafts. The four shafts is considered best for the distribution of power and for propulsive efficiency. At present experiments are being made in the Admiralty experimental tank with a view of determining which system of bracket is preferable, as it was found when the first tests were made that a very serious diminution of efficiency resulted from such large obstructions to the stream lines at the after end of the ship. This matter, as well as the proximity of propellers to the hull of the ship, is a problem which will require to be faced in connection with the use of multiple screws. The research work of the committee has shown that a considerable decrease in the weight of machinery cannot be realized even by the adoption of the turbine, and consequently the ships are likely to be of great size.

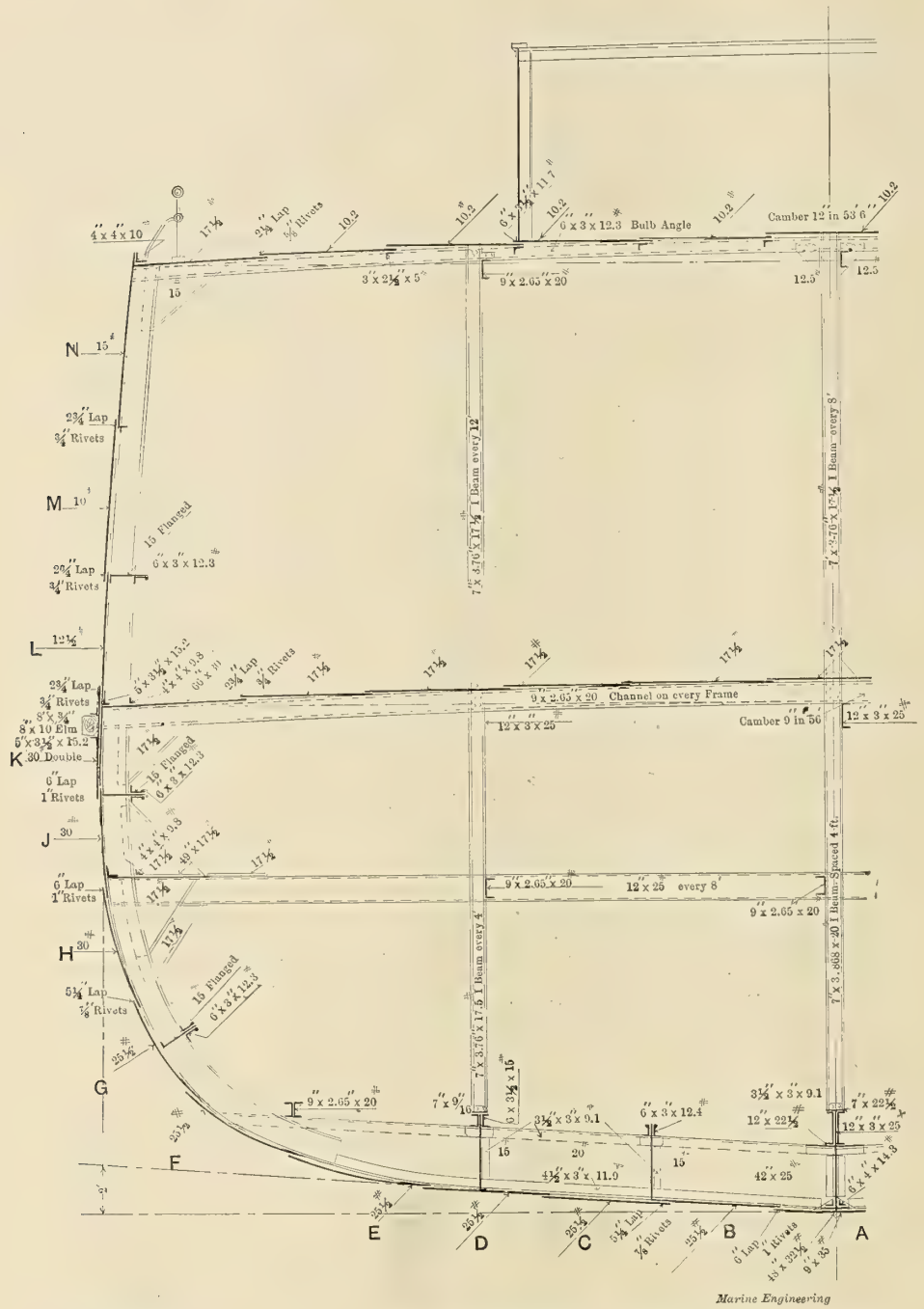
The proposal has been made to introduce the superheating of steam but with this there is some difficulty. In the early turbines of the Parsons system it was found that the composition of the metal forming the blades gave trouble with even a moderate degree of superheat. A change was made which very materially mitigated this difficulty. Shipbuilders, however, are looking with very considerable favor on other systems —among others the Curtis—with the possibility of using a high degree of superheat and the idea has been suggested that a very satisfactory combination would be the Curtis system for the high pressure turbine using superheated steam, with the Parsons for the low pressure turbine. But matters in connection with turbine are very largely in the experimental stage; it is recognized that the next year or two will witness very important developments in this branch of mechanical science.

X.

PERE MARQUETTE 19, A CAR FERRY OF THE LARGEST SIZE.

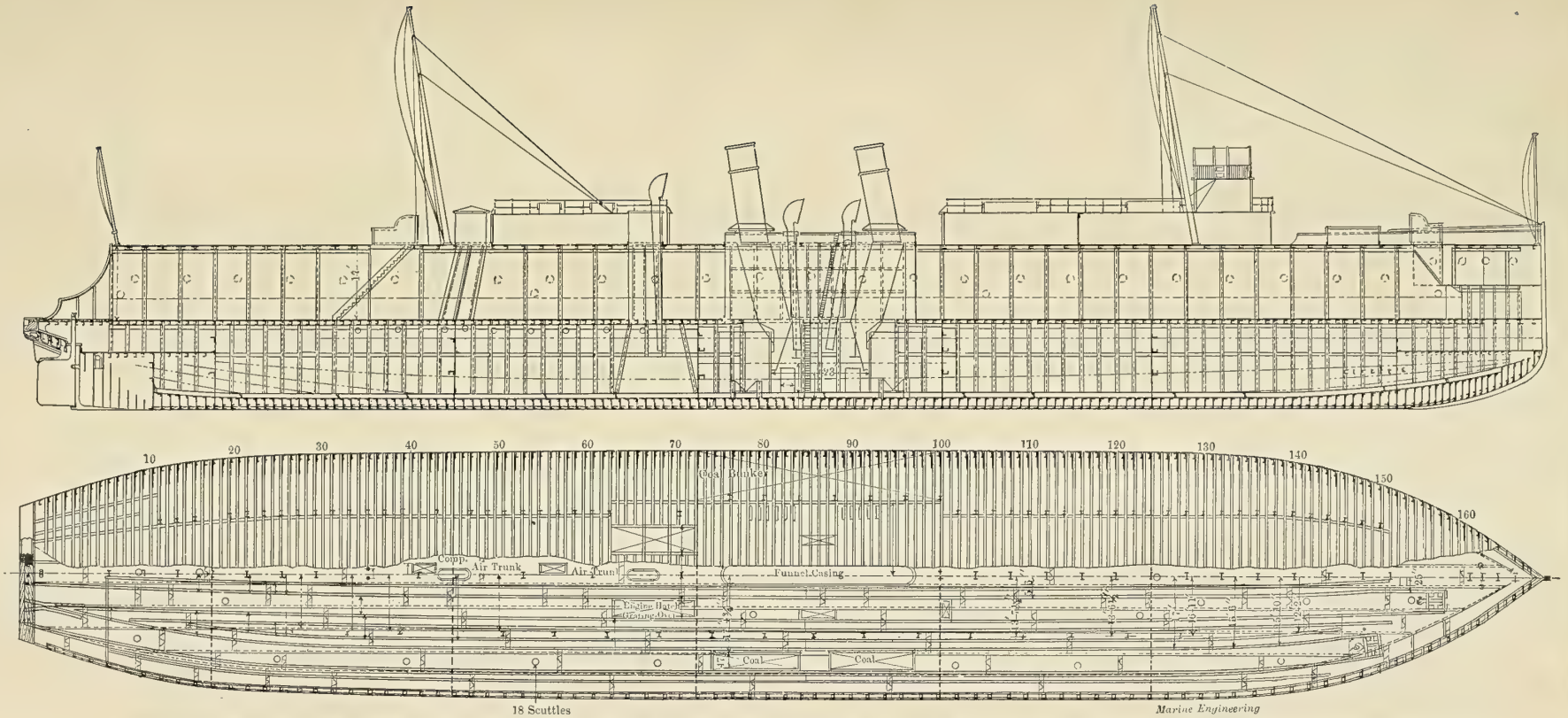
A few years ago there was described in this magazine the big car ferry *Pere Marquette* 17, built to the order of *20*, built by the American Shipbuilding Company, Cleveland, Ohio.

The hulls of these ships have to be of extra heavy scantling; first, to sustain the longitudinal and complex



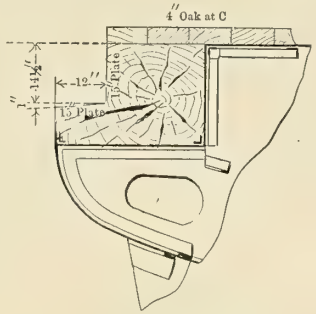
MIDSHIP SECTION OF THE STEEL CAR FERRY PERE MARQUETTE 19 FOR SERVICE ON LAKE MICHIGAN.

the Pere Marquette Railroad Company, which operates several car ferry lines on the northern waters of Lake Michigan. Increased business has required construction of more vessels, and there have just been completed for this company two large new ships, nearly identical to *No. 17*, except that there are no passenger accommodations, and named *Pere Marquette* 19 and *Pere Marquette* strains of supporting a rolling load such as heavy passenger and freight cars; and second, to give strength to withstand the heavy seas and ice encountered on Lake Michigan four or five months of the year. The shape of the hull is of the most approved form, to resist the crushing strains of the heavy ice. By referring to the midship section on this page, it will be seen that



LONGITUDINAL AND DECK PLANS OF THE TWIN SCREW STEEL CAR FERRY PERE MARQUETTE 19. LENGTH OVER ALL, 350 FEET; CAPACITY, 4 TRACKS FOR THIRTY FREIGHT CARS.

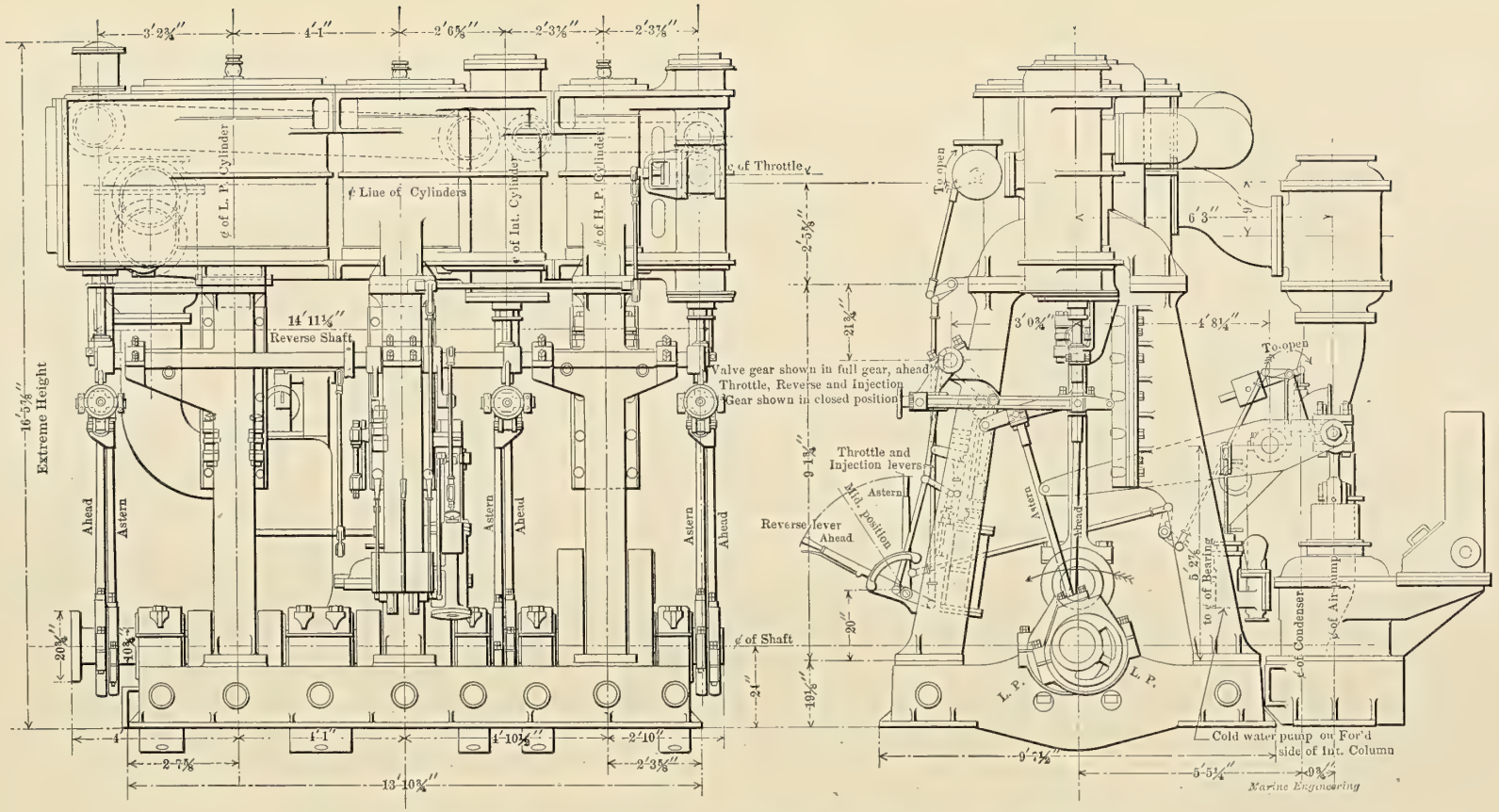
from the bilge up the frames are of heavy channel section and spaced 24 inches, alternate frames extending to the upper deck. The bottom frames are 4 1-2 inches by 11.9-pound angles. The floors are 30 inches deep at the centers and of 20-pound plate, with 3 1-2-inch by 9.1-pound reverse bar at top. They are connected to vertical keelson by double clips and strongly riveted to side frames. The flat plate keel is 48 inches by 32 1-2 pounds; the bottom and bilge strakes of plating 25 1-2 pounds; the upper bilge and side plating up to main deck are 30 pounds, with doubler on the main shear



DETAIL OF STERN POCKET.

strate; the top sides are plated with 12 1-2 and 10-pound plates, while the upper shear strake is of 15 pound.

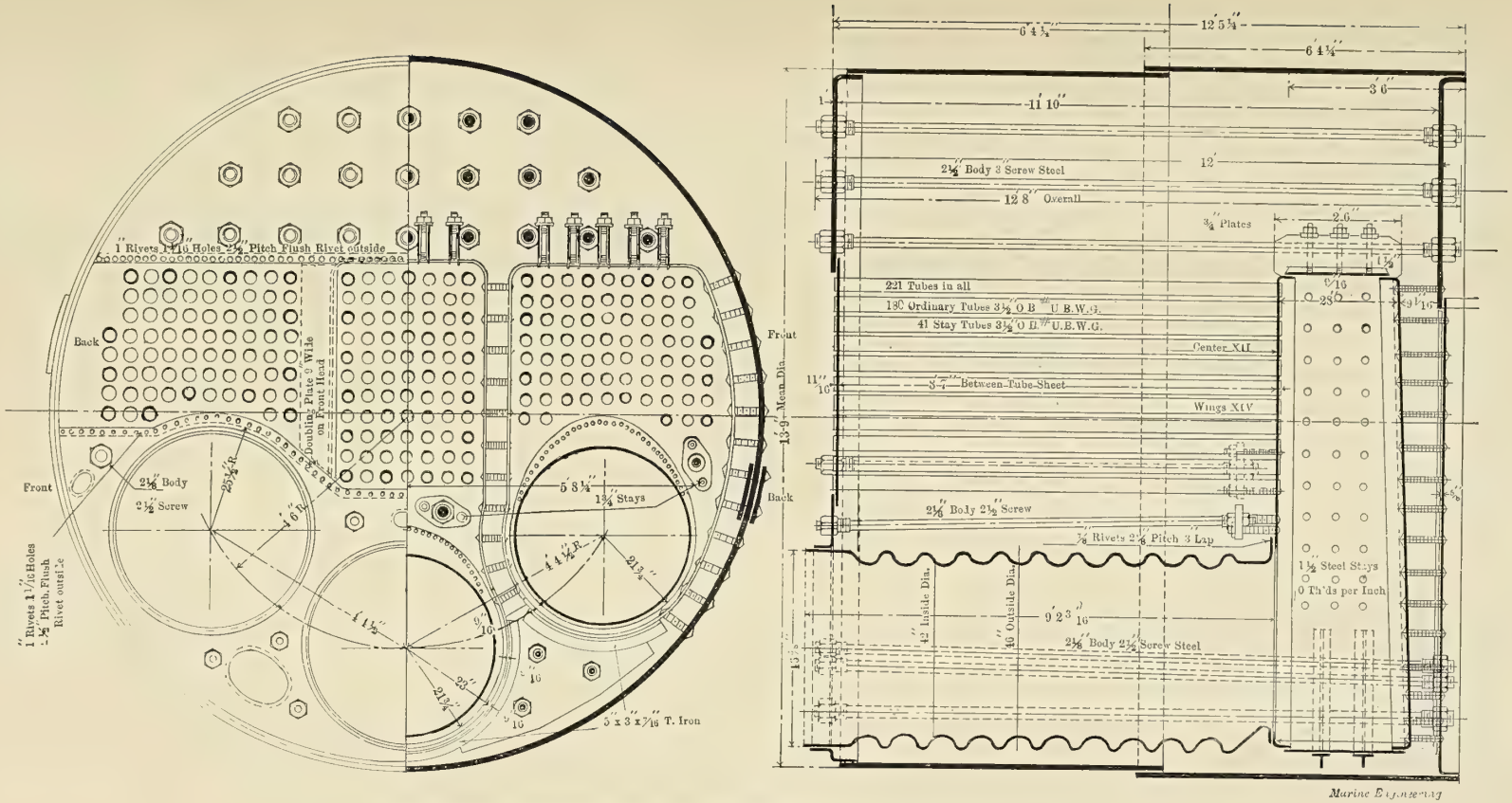
The foundation plates are securely riveted to the top of floors and connected to the center girder by 12-inch channels, and on top of these channels is a rider plate 7 inches by 22 1-2 pounds. Two side keelsons are fitted on each side, made up of intercostal 15-pound plates between floors, flanged to shell plating, the first keelson being topped with 6-inch by 12.3-pound bulb angles, and the other of 6-inch by 15-pound double channels. A heavy keelson made up of 9-inch by 20-pound angles



ONE OF THE THREE-CYLINDER TRIPLE EXPANSION ENGINES FOR THE STEEL CAR FERRY PERE MARQUETTE 19.

runs along the top of floors at intersection of frames. The bilge keelson is made up of intercostal flanged plates and double bulb angles. Side stringers are fitted as shown in the drawing. Channel beams 12 inches deep are spaced every 8 feet and connected to this stringer plate. Another side stringer, similar to the bilge keelson, is worked in between these beams and the main deck. The main deck plating and stringer are carried on channel beams spaced every 24 inches. The stringer is 66 inches by 30 pounds, and the rest of the plating 17 1-2 pounds. The main deck beams are supported by three rows of stanchions of I sections spaced every 4 feet, and to these are riveted continuous fore and aft girders made up of 12-inch channels, 3 lines under the main deck beams, and 3 under the hold beams. The upper deck beams are of bulb angle, and under these at the line of the stringers are erected similar channels fore and after. The center row of stanchions between decks are spaced 8 feet, and the outside rows 12 feet. The upper deck stringer is 17 1-2 pounds, and the rest of the deck 10 pounds.

The stem is heavy forging 11 inches by 4 inches, and the stern post also of the same dimensions. The frames for a space of 30 feet from the stem are heavily reinforced, and the plating is doubled to take the crushing strain when driving the ship into heavy ice. The propeller shafts are inclosed in spectacle framing with



ONE OF THE 4 SINGLE END CYLINDRICAL SCOTCH BOILERS FOR THE PERE MARQUETTE 19.

heavy cast steel brackets at the after end. At the water line is erected a continuous plate stringer 49 inches wide, securely connected to the shell and main frames by heavy angles, and bracketed above and below to the frames.

In the steel house forward are accommodations for captain and officers, and in the after cabin are the messrooms, accommodations for assistant engineers, stewards, watchmen and wheelsmen. The forecastle is located on the main car deck, and above this is a partial deck where is placed a steam windlass, mooring bits, chocks, etc. The firemen's quarters are forward of the boilers below the main deck.

As will be noticed from the drawing, the stern of the vessel is opened for taking cars on board. There are four tracks to accommodate in all 30 freight cars or 14 large passenger coaches. In making dock the ship backs in.

MACHINERY.

The vessel is driven by two sets of triple expansion engines, the diameters of the cylinders being 19, 31, and 52 inches by 36 inches stroke, which are placed entirely below the main deck. To the high- and intermediate-cylinders piston valves are fitted, while a double ported slide valve is on the low-pressure cylinder. All are worked by Stephenson link motion. The crank shaft is built up in one piece, with webs shrunk on, and is 10 3-4 inches in diameter. The air pump for each engine is driven from the intermediate cross head and is 30 inches in diameter by 12 inches stroke. The propellers are 12 feet in diameter by 14 feet pitch, of cast steel made

specially heavy to use in the ice. The air pump for each engine is worked from the intermediate crosshead. As is the custom on the Great Lakes, a jet condenser is used. Steam is supplied at 175 pounds pressure by 4 single-end Scotch boilers, each fitted with 3 furnaces and separate combustion chambers. The diameter of each boiler is 13 feet 9 inches mean, and the length is 12 feet. The other data will be found in the accompanying table and on the drawing of the boiler, page 183. In each boiler are 180 ordinary tubes 3 1-2 inches by 11 B. W. G. and 41 stay tubes, 3 1-2 inches by 7 B. W. G.

In the matter of auxiliary equipment this boat resembles her previous sisters. There are two main duplex compound feed pumps 8 by 12 by 5 by 10 inches, one pony duplex pump 8 by 5 by 10 inches, one duplex sanitary pump 6 by 4 by 6 inches, and one bilge pump 8 by 10 1-4 by 10 inches. The steering engine made by the shipbuilders after their own design has a double 8 by 8 inch engine. The boat is lighted throughout by electricity supplied by two direct connected sets, one of 15 kw. capacity and the other of 4 1-2 kw. The first boat, the Pere Marquette No. 17, was designed by Mr. Robert Logan, naval architect, and the success that it attained in contending with ice and storm, and performing regular service has done much to increase traffic, both freight and passenger, of the company.

MARINE ENGINEERING DATA CARD. APRIL, 1904.

NAME—Pere Marquette 19 and 20. NATIONALITY—American. TYPE—Car ferryboat

LAUNCHED—1903. BUILDER—American Shipbuilding Co. OWNER—Flint and Pere Marquette Railroad Co.

Length over all.....350 ft. 0 ins.
" between perps.....338 " 0 "
Beam, molded.....56 " 0 "
Depth, " to main deck.....19 " 6 "
" " " upper " .....36 " 3 "
Draft, load.....12 " 3 "
Displacement long tons, fresh water....4,010 tons
Capacity.....4 tracks for 30 freight cars
Engines:.....2 sets, triple
Cylinder diameters.....19, 31, 52 ins.
Stroke.....36 ins.
Valves.....Piston on H. P and I. P.
Bed plate, length over all.....13 ft. 10 3-4 ins.
Jet condenser.....
Air pumps....30 ins diameter by 12 ins. stroke
Crank, shafting diameter.....10 3-4 ins.
Thrust, " " .....11 "
Line, " " .....10 1-2 "
Propeller " " .....11 1-2 ins.
Revolutions per minute.....100
I. H. P., both engines.....2,350
Speed.....12.7 knots

Boilers:.....4 single end Scotch
Diameter.....13 ft 9 ins.
Length.....12 " 0 "
Steam pressure.....175 pounds
Furnaces, each.....3 Morrison
Diameter, inside.....42 ins.
Length of grates.....6 ft. 0 "
Tubes, Number 1 boiler.....221
Diameter.....3 1-2 ins.
Length between sheets.....8 ft. 7 "
Area through tubes.....12.73 sq. ft.
H. S., one boiler.....2,103 " "
G. S.....63 " "
Weight of boiler, dry.....75,500 pounds
" " water in boiler.....50,275 "
H. S. ÷ G. S.....33.38
H. S. ÷ I. H. P.....3.58
I. H. P. ÷ G. S.....9.34

Propellers: Number.....two 4 blades
Diameter.....12 ft. 0 ins.
Pitch.....14 " 0 "
Area, developed.....56.2 sq ft
Material.....cast steel

SEA STRENGTH OF THE PRINCIPAL NAVAL POWERS.

ISSUED BY OFFICE OF NAVAL INTELLIGENCE.

NUMBER AND DISPLACEMENT OF WAR-SHIPS, BUILT AND BUILDING, OF 1,000 OR MORE TONS DISPLACEMENT.

TYPE.	Great Britain.				France.				Russia.				Germany.				United States				Italy.				Japan.				Austria.			
	Built.	Tons.	Building.	Tons	Built.	Tons.	Building.	Tons.	Built.	Tons.	Building.	Tons.	Built.	Tons.	Building.	Tons.	Built.	Tons.	Building.	Tons.	Built.	Tons.	Building.	Tons.	Built.	Tons.	Building.	Tons.	Built.	Tons	Building.	Tons.
Battleships, first class*	50	669,000	9	142,600	20	223,621	6	87,800	17	201,129	8	112,864	14	152,581	6	77,962	11	125,129	13	192,700	14	173,276	5	63,155	6	84 300	..	.....	..	.....	3	31,800
Other battleships and coast defence ironclads	6	49,900	..	.....	20	94.615	..	.....	12	66,679	..	.....	16	90,773	..	.....	12	47,945	..	.....	3	12,244	..	.....	2	13,004	..	.....	11	62,480	2	16 720
Armored cruisers	27	262,800	14	166 000	15	113,767	8	91,849	8	71,261	..	.....	3	28.144	3	28,048	2	17,415	8	111 800	5	31 891	1	7.264	8	73,550	..	.....	2	11.520	1	7,400
Protected cruisers, first class (above 6,000 tons)	21	201,950	..	.....	4	31,513	..	.....	6	39,546	3	19 965	..	.....	..	.....	2	14,750	3	28,800	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....
Protected cruisers, second class (3 000 to 6,000 tons)	53	235 880	7	21 000	19	79,752	..	.....	5	19,450	3	9,445	9	46,949	..	.....	15	56,393	4	12,400	5	17,490	..	.....	10	41,226	3	10,095	2	8,128	..	.....
Other cruisers and scouts (above 1,000 tons)	44	96,510	8	21 610	18	32 840	..	.....	11	18,093	..	.....	31	69.427	4	11,715	23	32,773	2	2,170	11	23,937	..	.....	17	31 506	..	.....	6	11,785	..	.....
Totals	201	1,516,640	38	351,210	96	576,108	14	179,649	59	416,158	14	142,274	73	387,874	13	117,745	65	294,405	30	347,870	38	258,838	6	70,419	44	243,586	3	10,095	21	93,913	6	55 920
Combined totals	239 of 1,867,250 tons.				110 of 755,757 tons.				73 of 558,432 tons.				86 of 505,619 tons.				95 of 642,275 tons.				44 of 329,257 tons.				47 of 253,681 tons.				27 of 149,833 tons.			

*Battleships, first class, are of (about) 10,000 tons, or more, displacement, and are not more than 20 years old. The few exceptions as to age have been reconstructed and are given a modern armament.

N B.—Gunboats and other vessels of less than 1,000 tons are not given in the table, nor are transports, despatch vessels, converted merchant vessels, or yachts, or obsolete cruisers. Vessels not begun are not included in the table.

American Society of Mechanical Engineers.

The summer meeting of the American Society of Mechanical Engineers will be held in Chicago beginning on May 31 and continuing till June 3. The meeting is to be a joint session with the Institute of Mechanical Engineers of Great Britain, who have been invited by the former society to partake in this session. Nearly 200 members of the British Institute have expressed their intention of taking part in this meeting.

According to a notice sent out by Mr. F. R. Hutton, Secretary of the American Society, among the subjects of papers to be presented by the British Institute will be: Steam turbine, the gas engine, motor cars, hydraulic and electric cranes, induction fans, garbage destructors. The committee of meetings of the American Society has asked for papers on the American steam turbine, gas engine, power plant of tall office buildings, the American locomotive testing plant, shop management problem, and modern machine tools. It is expected that papers from both Societies will be distributed to American members in advance. Chicago has been selected by reason of the convenience of access to St. Louis, while securing the advantages of comfortable hotels which is practically impossible in an Exposition city.

New Erie Railroad Ferryboats.—Two of the three new steel double-decked screw ferryboats for the Erie Railroad Company have been placed in service. The boats are from designs by Mr. J. W. Millard, naval architect, New York. The *Tuxedo,* the first on the line, was built by the Harlan & Hollingsworth Company, and the *Arlington,* which has just been delivered, came from the yards of the Burlee Dry Dock Company, Staten Island. The boats are 234 feet long over all, 64 feet beam, and 17 feet 9 inches depth of hull. The propelling machinery consists of two compound engines working on a shaft which is continuous from end to end of the boat.

American Shipbuilding.—The Brotherhood of Boiler Makers and Iron Shipbuilders of America has issued an appeal through its president, John McNeill, to the members of Congress, urging the passage of the bill before the House and Senate for the creation of a commission to recommend legislation for the development of the merchant marine. The plea is that as ships cannot be built in the United States as cheaply as in foreign lands, largely because of the increased wages received in this country, that the government should protect the laborer against the free competition of foreign ships.

Alcohol for Industrial Purposes.—The use of alcohol in the arts has been the subject of much investigation and experiment abroad, and several different forms of alcohol motors have been brought out. At present there is a bill before Congress, providing that denaturized alcohol, which is not fit for drinking purposes, shall be exempt from taxation. Many years ago such legislation was enacted in Germany, which resulted in the extensive use of alcohol for industrial purposes. With a view of reducing the price of alcohol for industrial or chemical purposes by removing the import duty upon it, the Russian government has offered a prize of about $25,000 to the person, whether Russian or foreigner, who discovers a denaturizing substance, such as shall fill the requirements of making it undrinkable, yet at the same time not destroying any of its chemical or thermal reactions.

Meeting of Institute of Naval Architects.

The Annual Meeting of the Institute of Naval Architects of Great Britain will be held in the Hall of the Society of Arts, John street, Adelphi, London, W. C., on March 23 to 25 inclusive. The following papers will be presented and discussed:

1. *The Battleships Triumph and Swiftsure (ex-Chilian Libertad and Constitucion).*" By Sir Edward Reed, Vice-President.
2. *Merchant Cruisers and Steamship Subsidies.* By the Right Hon. Lord Brassey, Past President.
3. *On the Establishment of an Experimental Tank for Research Work on Fluid Resistance.* By Sir William H. White, Vice-President.
4. *Some Results of Model Experiments.* By R. E. Froude, Member of Council.
5. *On the Heeling and Rolling of Ships of Small Initial Stability.* By Professor A. Scribanti, R.Ital.N.R., Member.
6. *Gyroscopic Effect of Fly Wheels on Board Ship.* By Herr Otto Schlick, Member.
7. *Some Advantages of Gas and Oil Engines for Marine Purposes.* By J. E. Thornycroft, Associate.
8. *Internal Combustion Engines for Propelling Small Vessels.* By A. F. Evans, Visitor.
9. *Steam Turbine Propulsion for Marine Purposes.* By Professor A. Rateau, of Paris.
10. *Some Points in Connection with the Transverse Sterngth of Ships.* By J. Bruhn, Member.
11. *Normal Pressures on Thin Moving Plates.* By A. W. Johns, Visitor.
12. *Ships' Composition.* By A. C. A. Holzapfel, Associate.
13. *Fire Prevention on Ship Board.* By Edwin O. Sachs, Associate.

Lackawanna Railroad's New Ferryboats.—The contract has been awarded to the Newport News Shipbuilding & Dry-Dock Company, Newport News, Va., by the Lackawanna Railway for four large steel screw double-decked ferryboats for the railroad company's new Twenty-third street ferry, New York. The boats will have a length of 231 feet, a beam of 62 feet over all, and a draft of 10 feet 6 inches. Two sets of compound engines, developing 1,400 I. H. P. are to be installed furnished with steam by two Scotch boilers. The designed speed is to be 14 miles. The general finish of the interior is to be colonial with mahogany seats, stairs, and moldings. The boats will be heated and ventilated by an indirect hot air system. The floors of both upper and lower cabin will be laid in rubber tiling. Each boat is to have a capacity of a thousand passengers. The plans have been furnished by Gardner & Cox, 1 Broadway, New York, N. Y., working in consultation with Col. E. A. Stevens of Hoboken.

Government Supplies in American Ships.—The Senate has passed a bill requiring the transportation of Government supplies in American ships. The provisions of the bill are as follows: "That vessels of the United States, or belonging to the United States, and no others, shall be employed in the transportation by sea of coal, provisions, fodder or supplies of any description, purchased pursuant to law, for the use of the army or navy, unless the President shall find that the rates of freight charges by said vessels are excessive and unreasonable, in which case the contracts shall be made under the law as it now exists; provided, that no greater charges be made by the vessels for transportation of articles for use of the said army and navy than are made by such vessels for transportation of like goods for private parties or companies. This act shall take effect sixty days after its passage."

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE past year has not been one which the American shipbuilder is likely to look back on with any special feelings of satisfaction. The past, however, belongs to itself and should only merit consideration from the shipbuilder and engineer as he may be able to draw therefrom wise lessons for his future guidance. The modern captain of industry must have his face set steadfastly to the future and, avoiding the mistakes of the past, must look forward to the "coming season" as the arena of his industrial campaign. What then does the coming year hold of promise for the American shipbuilder and marine engineer? Are there discernible prospects of a revival of activity in the shipbuilding interests, and if so, where are they to be sought? The gift of prophecy is one rarely met with in the present age, and we shall not attempt more than the mention of a few points which may have some bearing on the questions of such vital interest to American shipping.

First a word as to the function of new legislation in the development of prosperous maritime conditions. We may admit freely that there is unquestionably sore need for legislation more perfectly adapted to the demands and conditions of the present day, and which shall, so far as legislation can, give to the shipping interests a just balance of opportunity with reference to both the world as a stage of activity, and American industries as affecting our own national status and development.

It is obviously unfair to expect that the shipping interests, viewed from the standpoint of internal national development alone, shall be made the beneficiary of selective legislation at the expense of other national industries. It is likewise unfair to expect that an industry, which must necessarily take the whole world as a stage, can find an equal chance in the world competition if restricted by legislation which takes no cognizance of international relations and economic conditions, and which has reference to domestic development and internal economy alone.

Between these two horns of the dilemma our shipping interests have long suffered, while it seems clear that some wise compromise might be worked out, and that some legislation might be devised which should give to these interests a fair measure of opportunity in the world competition, without at the same time giving them an unfair advantage with relation to the other internal interests. What the details of such legislation should be we shall not attempt to determine at the present moment, but we do believe that these general views are becoming more clearly understood both by the law makers and by the American people at large, and that the day is not far distant when these subjects will begin to receive the attentive study which they deserve, and that some measure of legislative relief will be found which shall help the shipping interests where they need help, and without unfairness to other forms of domestic industry.

With this faith, however, we must not forget that no amount of legislation can direct capital into a channel which is not attractive and promising as an investment. Capital always seeks the field which will yield the largest and surest returns, and it is an unquestioned fact that during the period of industrial development and expansion since the close of the Civil War, the demand for capital in domestic commerce and industry has been so great and the returns have been so much larger than could be expected from investment in foreign commerce and shipping, that there has been but small extra capital for such ventures and

but small inducement to investors in such fields. There are indications of a change here. The development of internal industries has its limit unless a world market is sought, and the world's markets can not be entered on a basis of successful competition without some share of control in the world's carrying trade and shipping interests. Again, wonderful as our internal development has been during the past forty years, it hardly seems likely that for the future this class of interest can absorb so large a share of available capital to the exclusion of international commerce and shipping. If we mistake not, the trend of the age is toward a share of activity in the world's business at large, and this means more American ships and shipping as a necessary means to the end. As for the present depression, the pendulum between over and under production is always swinging one way or the other. Just now we have reached a point where the fresh demand is small, and the production in the immediate past is adequate. But just as surely as the pendulum has thus swung to and fro in the past, so surely may we look in the future for tendencies in the direction of fresh orders and increasing demand. How soon these conditions may reach us we may not attempt to say, but the present condition should only be looked on as temporary and due to special and local causes which time and new conditions will speedily remove.

Again, having in view the prospect of work on the Panama Canal and the assured policy of the Government to maintain its navy and its place as a world power, together with the general assurance that as a nation we are not growing poorer but richer, and that the same causes which in the past have given prosperous times for shipbuilders and owners are still in operation; these various facts, with others as mentioned above, all give ground for hope, and we confidently look for a future development of American shipping and commerce which shall far exceed the modest expectations which at the present time we may be justified in forming from the immediate outlook.

At last the plans for a united engineering building in New York city for the accommodation of the leading engineering societies have been definitely decided upon and it is expected that work on the new building will be taken up at once. Several months ago Mr. Andrew Carnegie addressed a letter to the American Society of Civil Engineers, American Society of Mechanical Engineers, Institute of Mining Engineers, Institute of Electrical Engineers, and the Engineers' Club of New York, stating that he would place at their disposal one and a half million dollars for the erection of a united engineering building to accommodate the different societies. These plans have already been discussed in previous issues of this magazine, and suffice it to add that the great advantages to the constituent societies resulting from this munificent gift would be, in the erection of a splendid building especially designed to fill the requirements of all the societies in providing adequate auditoriums, library and lecture rooms, and a reduction in the operating expenses of each society, thereby permitting the funds to be of more direct benefit to the members, such as, carrying on scientific research. No society, however, will lose its individuality, for it was not the intention to amalgamate the different institutions themselves.

The question of the acceptance of Mr. Carnegie's gift was voted on at once by the membership in all the societies, except the civil engineers, and, as was to be expected, an overwhelming vote in the affirmative was recorded. The vote of the civils has but recently been reported, and stood 1,139 to 662 against the proposition. Fortunately, however, their action will not defeat the proposition for Mr. Carnegie has repeated his offer to the four other societies.

Some of the smaller technical societies have, we understand, applied for accommodation in this projected building, and it is stated that the plans will provide for office and meeting room space to accommodate these societies. This will, indeed, be a great boon to thus assist those societies which have not the financial strength of the larger ones. Among those which have applied to the general committee is the Society of Naval Architects and Marine Engineers. This society, organized ten years ago, has carried on splendid work, and brought out much valuable engineering data before the profession. Its numerical and financial growth has been slow, but increasing each year, and the time apparently has at last arrived when it may occupy permanent quarters.

The strengthening of the societies, which will follow the opening of this splendid building, will be of very great value to the profession generally. Mr. Carnegie has always been a friend of the engineers, and in thus dedicating a building to the profession he acknowledges the great service the profession has rendered him in his life's work.

Care of Boilers.

Editor Marine Engineering:

I read with great interest "Old Scotch's Reverie," by C. A. McAllister, U. S. R. C. S., in your issue of March. It is instructive and amusing and, in my judgment, is the best article ever written on the subject. Could a copy be placed in every engineer's hands in the world, it would be worth millions of dollars to steamship owners. The money-earning value of steam boilers depends upon their being properly arranged for cleaning, as well as for the consumption of fuel.

In the early days of the surface condenser there was much trouble with galvanic action in boilers; in several cases the boilers were in three years so badly affected with this trouble that they had to be taken out of the vessels. In 1870 the Old Dominion Steamship Company had a steamer built by the Harland & Hollingworth Company of Wilmington, Del., named the *Wyanoke* and her engine was fitted with a surface condenser, the first in the line. After running about six or eight months, the braces and rivet heads in the shells of the boilers were found to be seriously affected, many of the rivet heads wasted away, and some of the braces scored a quarter of an inch in depth. We cleaned and painted, but still the trouble continued.

Talking about these troubles to Mr. Henry Leveret, constructing engineer for Mr. John Roach of the Morgan Iron Works, he informed me that the French engineers running between New York and Havre, France, used sal-soda in their boilers. This we gave a trial with fairly good results, but the trouble continued more or less. The late Henry G. Hill, chief engineer of the ship, spoke to W. W. Wood, chief engineer, U. S. N., about our troubles with the *Wyanoke's* boilers, and Mr. Wood advised us to use cast zinc plates in our boilers, with the sal-soda. It absolutely stopped all our trouble, and we were a happy lot of engineers. This practice I used for thirty years in all of the company's steamers fitted with the surface condenser and with satisfactory results.

In 1872 the steamer *Old Dominion,* following the *Wyanoke,* ran nineteen years before her boilers needed retubing, she is running at this date with the same boilers she started with thirty-two years ago; however, I have learned, that during this last winter she had had her furnaces and tube heads renewed. This steamer has run more miles than any steamer in the world.

We have engineers at this date who do not know any better than to claim that the expenditure for zinc in boilers is useless, as they would do just as well without it; I would advise them to read "Old Scotch's Reverie."

Geo. V. Sloat.

San Francisco Technical School.

Editor Marine Engineering:

In this day of technical education, San Francisco has not been behind her sister cities in taking up the burden of caring for the needs of the great working classes. San Francisco is to-day, through her natural facilities, one of the foremost ports of the world. The opening of the Isthmian canal will place her in the front rank of the world's maritime cities.

San Francisco early learned the value of training those who "go down to the sea in ships." As far back as I can remember there was a weather-beaten sign by the old Fourth street bridge advertising a night school in navigation and seamanship for seamen who study for examinations for licenses.

The first class in naval architecture was established under the auspices of the Mechanics' Institute in 1895 by a draftsman in one of our leading shipbuilding firms and a graduate of our state university. This class was quite successful and well attended.

In 1897 the board of education was persuaded to start a class of mechanical drawing in a room of the Polytechnic High School. This class of 35 students grew so rapidly that it was removed to the basement of the Humbolt school. It is now known as the Drawing Department of the Humbolt Evening School. To-day, without advertisement of any kind, there are 375 students on the roll. Eleven instructors are employed, giving instruction to the following classes: Two naval architecture, one marine engineering, one electrical engineering, one mining and mill work, one architecture, two miscellaneous mechanical work, one mathematics, one chemistry and physics.

The instructors are young men having practical experience in the branches they teach, working in our principal engineering firms by day and teaching apprentices from the same shops by night. Thus problems which come up during the work of the day can be discussed in the class at night, and so employer as well as employee gets the benefit. The teachers are well acquainted with engineering conditions. It is their aim to give personal instruction; to make the pupil the personal friend of his instructor, giving him another incentive for work. It is an inspiration to attend these classes of bright and earnest young men. It is no easy thing for these men to teach and study after a hard day's work, therefore they should be encouraged.

So large has this work grown that the present quarters are inadequate, there being 53 applicants now awaiting vacancies. The board of education is to erect a new polytechnic school; the upper floor and attic are to be used to accommodate these classes. The Humbolt Drawing Class will then be known as the San Francisco Evening Technical School and will accommodate 600 pupils. Additional classes in marine and electrical engineering and architecture will be formed, and new classes in structural engineering, special and automatic machinery, gas-engine construction, and hydraulics. It is proposed to establish a good technical library and working model room where students may see the various processes in the different trades.

Wm. Decker.

PERSONALS.

W. Carlisle Wallace, formerly of Sheffield, has been appointed the American representative of John Brown & Company, Ltd., Sheffield, England, and opened offices at 22 Thames street, New York, N. Y.

L. Williams has been appointed chief refrigerating engineer of the United Fruit Company, Boston, Mass. Mr. Williams was formerly general manager of the American-Linde Refrigerating Company.

Chas. Lang, who has been connected with the engineering, purchasing, and sales departments of the Wheeler Condenser & Engineering Company, for the

past nine years, has resigned and is taking a much needed rest. He is now considering several offers.

Erwin S. Cooley has accepted a position with the Turbine department of the General Electric Company, Lynn, Mass. Mr. Cooley was formerly with the Buffalo Forge Company and the Newport News Shipbuilding and Dry-Dock Company.

OBITUARY.

Russell W. Davenport, general manager of the Wm. Cramp & Sons' Ship and Engine Building Company, died in Philadelphia, March 2, 55 years of age. Mr. Davenport, who was a Yale graduate, at one time was with the Midvale Steel Company and later was general manager of the Bethlehem Steel Works. He was considered an authority upon the manufacture of steel, especially of guns and armor plate.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports under date of March 9, 1904, the following degree of completion of vessels building for the United States Navy:

			Degree of Completion. Per Cent.	
BATTLESHIPS.			Feb. 1.	Mar. 1.
Ohio	18 knots.	Union Iron Works	85.5	88
Virginia	19 "	Newport News Co	53.8	55
Nebraska	19 "	Moran Brothers Co	37.7	41.6
Georgia	19 "	Bath Iron Works	45.4	47.6
New Jersey	19 "	Fore River S. and E. Co	50.3	52.1
Rhode Island	19 "	Fore River S. and E. Co	51.7	54
Connecticut	18 "	Navy Yard, New York, N. Y.	28.5	30.86
Louisiana	18 "	Newport News Co	37.55	40.56
Vermont	18 "	Fore River S. and E. Co	3.6	4.6
Kansas	18 "	New York Shipbuilding Co.	3.9	5.2
Minnesota	18 "	Newport News Co	14.73	18.29
Mississippi	17 "	Wm. Cramp and Sons	0.	0
Idaho	17 "	Wm. Cramp and Sons	0.	0
ARMORED CRUISERS.				
Pennsylvania	22 knots.	William Cramp and Sons	66.8	68.6
West Virginia	22 "	Newport News Co.	73.32	76.76
California	22 "	Union Iron Works	54	56.5
Colorado	22 "	William Cramp and Sons	71.8	73
Maryland	22 "	Newport News Co	69.15	71.22
South Dakota	22 "	Union Iron Works	50	52.5
Tennessee	22 "	William Cramp and Sons	16.6	19.5
Washington	22 "	New York S. B. Co.	13.9	17
PROTECTED CRUISERS.				
Denver	17 knots.	Neafie and Levy	98	98
Des Moines	16½ "	Fore River S. and E. Co	99	99.5
Chattanooga	16½ "	Lewis Nixon	72	72.6
Galveston	16½ "	Wm. R. Trigg Co	72	73.5
St. Louis	22 "	Neafie and Levy	37.9	38
Milwaukee	22 "	Union Iron Works	42.5	44.5
Charleston	22 "	Newport News Co.	60	64.5
GUNBOATS.				
Dubuque	12 knots.	Gas Engine and Power Co.	22.2	29.1
Paducah	12 "	Gas Engine and Power Co.	25	25.5
TRAINING SHIPS.				
Cumberland	Sails	Navy Yard, Boston	25.5	26
Intrepid	"	Navy Yard, Mare Island	7	9
TRAINING BRIG.				
Boxer	Sails	Navy Yard, Portsmouth	10	20
TORPEDO BOATS.				
Stringham	30 knots.	Harlan and Hollingsworth	93	93
Goldsborough	30 "	Wolff and Zwicker	99	99
Blakely	26 "	George Lawley and Son	99	99
Nicholson	26 "	Lewis Nixon	99	99
O'Brien	26 "	Lewis Nixon	98	98

QUERIES AND ANSWERS.

Q. 198.—Will you please answer the following question upon the stability of ships:

Why should the center of support be taken at the same point as the center of gravity of the volume displaced in a floating boat?

In the accompanying figure all pressures pass through the center of the cylinder and hence also the resultant. According to theory, the resultant pressure comes from the center of gravity of the water displaced, *S*. J. P. B.

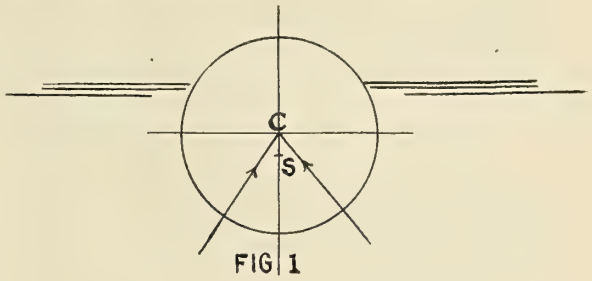


FIG. 1

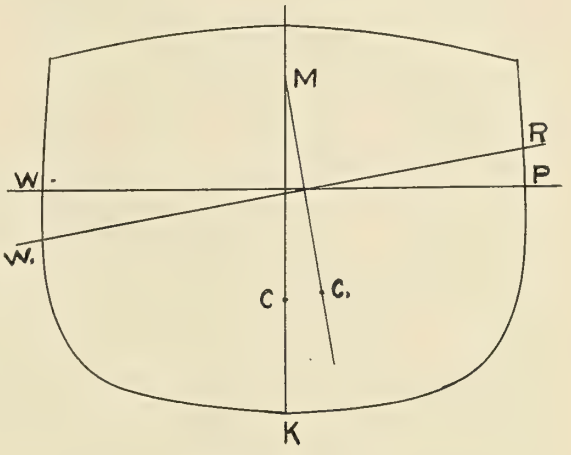


FIG. 2.

A.—There seems to be here some uncertainty in the use of the terms center of support and center of gravity of volume displaced. It is perfectly correct that with a body of the form shown, all surface pressures pass through the point *C*, and it is equally true that this point *C* is the point or center of support, so far as that term has meaning when applied to a floating body. The facts are briefly as follows:

In the case of any floating body as in the figure, with water plane at *W P*, the vertical resultant of all the individual supporting forces which act on the surface will of course be vertical and will act on a line drawn vertically through some point *C*, the center of gravity of the displaced volume *W K P*.

This statement does not fix the point of application of the supporting forces at the point *C*, but simply asserts that it will act along a vertical line passing through this point. Similarly if $W_1 P_1$ is a second water plane corresponding to a slight inclination to the original position, then in such position the resultant of the supporting forces will lie on a vertical line drawn through some point C_1 adjacent to *C* and found as the center of gravity of the displaced volume $W_1 K P_1$. Now if the second

position is very near the first the two lines through *C* and *C*, will be nearly parallel and will intersect at some point *M* which, as may be shown by higher mathematics, will be practically stationary for any position of the ship very near the original one, or differing only by four or five degrees. Or to put the matter more definitely, suppose the ship starting in the condition shown with water plane at *W P*, is inclined in both directions to the following angles: 1° 2° 3° 4° 5°. Then it would be found that all of the lines of support drawn through the points similar to *C* would pass practically through a single point *M*. This point is known as the metacenter and is the real point of support. In other words if we suppose the ship to roll back and forth about the first position through a small angle, the varying line of support will pass constantly through or indefinitely near to *M*, which thus becomes a force center or point of support for the ship in this position. If the angle of heel is greater, as 15 or 20 degrees, the line of support will usually not pass through *M*, but will shift to one side or the other. Still for such an inclination as 20 degrees there will be another point which will be a force center or point of support for this position, and through which the lines of support would pass for very slight changes of inclination on either side of the 20 degrees point.

It thus appears that the metacenter is the point of support and not the center of buoyancy or center of gravity of the displaced volume.

It is true that the latter is often spoken of as though it were a force center, but such language is inexact, and in reality it is the metacenter, as above stated, that really constitutes the point of virtual support. In the case of the body which you mention the metacenter remains constantly at the center *C*, and therefore this point remains constantly the point of virtual support.

In the general problem of the equilibrim of a floating body the centers of buoyancy and the curve which they build up as the ship is heeled through successive angular positions, are of great importance and are made the subject of extended investigaition. They serve, however, only as an intermediate step in the examination of the problem, and the real question of equilibrim is determined by the center of gravity of the ship and the relative location of the metacenter as defined above.

Q. 199.—Would you please give me your advice on the following and decide which is right? Description of engine: Vertical fore-and-aft compound, surface condensing; cranks at angle of 90 degrees; L. P. engine following the H. P. engine; size of engine, 14 inches by 28 inches by 22 inches stroke; boiler pressure per gauge, 108 pounds; vacuum per gauge, 24 inches; receiver, 3.5 times the capacity of H. P. engine; revolutions per minute, 136 (full speed); pitch of wheel, 8 feet 6 inches; H. P. engine, cut-off at 12 inches from head end and 11 1-2 from crank head; L. P. engine, cut-off at 20 inches from head end and 18 1-2 from crank end. At full speed receiver shows only 2 pounds by gauge or 17 pounds absolute, and at 110 revolutions about 14 pounds absolute; from cards taken the H. P. engine shows about 1-3 more H. P. than the L. P. engine, and at 110 revolutions it is twice as much.

M. K. maintains that by carrying the cut-off so far on the low that all the power is utilized, but if the cut-off were earlier it would be at a loss of power as a whole. He also maintains that the larger the receiver the better.

I say that the power as a whole is not affected by the L. P. being cut off early or late, but that an earlier cut-off on the L. P. will put more power on the L. P. engine and less on the H. P. engine. I also maintain that the receiver is too large and would be better if reduced to twice the cubic contents of H. P. engine at the time of cut-off.

What cut-off would you advise on the L. P. engine to equalize the power (at 136 revolutions) if we allow 8 pounds loss of pressure from boiler to H. P. engine, viz.: 100 pounds per gauge, supposing the H. P. engine to remain at 12 inches cut-off (that is all the boiler will supply when wide open) or what would you suggest to get the best results? L. W.

A.—You are quite correct in your claim that a change in the cut-off on the L. P. cylinder will not affect the total power developed but only the distribution of power between the H. P. and L. P. cylinders. This may be seen more clearly by remembering that in a general way the total amount of work developed in the engine will be determined by the amount of steam which enters the H. P. cylinder, and this will be determined by the H. P. cut-off only, and will not be affected by the L. P. cut-off. Or put in other words, the L. P. cut-off can not affect the total power developed, because it does not affect the amount of steam which is admitted to the engine. On the other hand the point of L. P. cut-off will affect the pressure at which cut-off takes place, and hence the back pressure in the H. P. cylinder; in general the earlier the L. P. cut-off the higher the pressure, and the later the cut-off the lower. Hence the earlier the cut-off the greater the back pressure in the H. P. cylinder, and the less, therefore, the power developed in this cylinder, while the more will be developed in the low. On the other hand the later the L. P. cut-off the lower the back pressure in the H. P., the greater the power developed in this cylinder, and the less the power in the L. P.

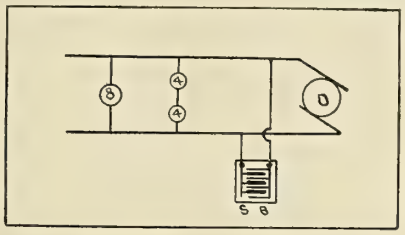
In the case which you mention the cut-off of L. P. is at 19 1-4 inches on the average, or 7-8 stroke. This is so late as to insure the development of much more than half the power in the H. P. and much less than half in the L. P. These conclusions are borne out by the receiver pressures which are much lower than they should be. In order to even matters up, the L. P. cut-off should be brought back to about 15 inches or 70 per cent. on the average. As nearly as the point can be determined by estimate, this should approximately even up the power in the cylinders.

Regarding the receiver, a volume of 3.5 times the H. P. cylinder is unnecessarily large and the results would probably be somewhat better with decreased size, though the actual performance of the engine varies only slightly for a considerable variation in receiver volume. The change most simply made, and most clearly indicated by your data, is to cut-off earlier in the L. P. cylinder, and probably all needful adjustment of power may be made without difficulty by a suitable location of this point.

Q. 200.—I have trouble with the hammer sparker of my gas engine and would like to be advised concerning a better form of igniter. I want a few lights on my boat, say an 8 C. P. hung over the motor and a couple of 4 C. P. lights in the cabin. Also would like to have a small searchlight. Will you please tell me what the best arrangement for this outfit will be. The muffler on my engine is not satisfactory, and I would like to know the best proportions to make the new one.

A.—We would recommend a jump spark igniter for your engine, as there are no moving parts inside of the cylinder, and you will find that by advancing the lead you can get more speed and power out of your motor.

Two 4 C. P. lamps of 6 volts each can be run in series and these two in multiple with an 8 C. P. lamp of 12 volts. In the sketch, *D* is the dynamo, *SB* the storage battery, 4,4 the two 4 C. P. lamps in series and 8 is the 8 C. P. lamp in multiple with the two 4 C. P. For a searchlight, we would recommend the use of acetylene, which gas could also be used in lighting your cabin in place of the three electric lights.



For your boat use a muffler of about five times the cubic capacity of the cylinder and if possible pipe the cooling water from the engine into the pipe leading to the muffler and provide a drain pipe from the lowest point of the muffler. The water condenses the hot exhaust gases and aids materially in muffling.

Q. 201.—Will you please tell me if the stern posts of ocean ships do not become magnetized? While a boy I was in one of the old shipyards on the Atlantic coast and, if my memory serves me right, the stern posts of ships coming in for repair were found to be highly magnetized.

A.—If your boyhood does not carry you back beyond the time of steel ships our observation was correct, for the stern posts and propellers of many ships do become electrified. The conditions are much like those of an electric battery, the steel stern posts and hull forming one electrode, the bronze propeller blades the other, and the salt water the solution of the battery. As the propeller is the positive terminal and the ship the negative terminal, the current flows from the ship to the propeller, causing the pitting of the steel hull. In order to overcome this galvanic action, most ships have zinc plates fitted, in single screw ships to the after face of the stern posts, and in twin screw ships fitted round the after propeller bracket. This does not eliminate galvanic action but such action takes place between the propeller blades and the zinc plates instead of propeller blades and the steel plates.

Q. 202.—Will you kindly advise me through your columns regarding the following:

A. Why is not the "jump spark" system of ignition, which is so popular among automobile builders, more used in gasoline marine motors?

B. In what essential features should a four-cycle, double cylinder, marine motor of 6 to 10 H. P. vary from the typical vertical automobile motor? The motor is to be used in a cruising launch.

C. In a four-cycle marine motor of the above type and size, to develop its rated power at 400 or 500 R. P. M., what is a good ratio of clearance to piston displacement, cylinder diameter to stroke, stroke to length of connecting rod? D. W. L.

A.—The jump spark has not been used for marine motors, owing to the fact that the spark plugs as first constructed were improperly insulated and most of them absorb moisture and short circuit, giving no spark at the points.

Now there are plugs with stone, mica and glazed porcelain that give good results for marine motor use.

You can now obtain jump spark coils that are thoroughly waterproof and by using rubber-covered wire for the leads you will find the jump spark preferable to the hammer break, as it is so easy to advance the lead and increase the revolutions of the motor, also the boat speed.

B.—A four-cycle, double cylinder marine motor need not vary from the typical automobile motor except in the arms or projections by which it is suspended, and some styles of automobile motors can be set in a boat without any change.

C.—A 5 by 5 inch double cylinder, four cycle, will give 10 I. H. P. at 500 R. P. M. This will give 7 1-2 to 8 H. P. on the brake. We would advise running this size engine up to 720 R. P. M., if the ports and valves are correctly designed. This will give 14 I. H. P. and 10 1-2 to 11 1-4 H. P. on the brake.

The combustion chamber contents should be 25 per cent. of the piston displacement. For marine work it is usual to make the bore and stroke equal. It has been found in stationary gas engine practice that making the stroke one and one-half times the bore gives the best results for economy of fuel.

The connecting rod should be twice the length of the stroke for marine use, the longer it is the less side thrust of the piston on the cylinder walls there is, but it is usually made as stated so as to get as short an engine as possible.

Q. 204.—We have recently had considerable discussion with some local parties about two-furnace Scotch marine boilers. These boilers were 12 feet in diameter, designed by their engineer, made of 1-inch plate and each one contained two 50-inch furnaces and had double combustion chambers. The double combustion chambers and large furnaces involved boilers which, to our mind, were larger than there was any necessity for, and by making the furnaces 46 inches in diameter and with a single combustion chamber, we cut the boilers down to 11 feet 6 inches diameter, making them of 15-16-inch plate, saving them considerable in first cost. Our argument was that their double combustion chamber, when there were two boilers, was without any logical grounds for preference over a single combustion chamber; in fact, we maintained that two-furnace boilers, unless there were but one in a boat, were almost invariably constructed with single combustion chamber. The advantages of the single combustion chamber which we presented were the facts that by stoking the fires alternately, very much better combustion was assured, as the volatile gases from the new fire were met by the hot flame in the other combustion chamber and were partially consumed. Their chief argument against a single combustion chamber was that in firing, the cold air admitted by the firing door was distributed all through the boiler, instead of through one-half of it. This seemed to us to be a ridiculous argument, for the reason that only a given quantity of cold air could enter in the brief period the door was open, and the effects of this might better be distributed through all the tubes than half of them. They claimed that their preference for a divided combustion chamber was sustained by nearly all recent engineering practice. Will you kindly have your expert look over the various phases of this question and advise us as to the standing of the contention in reference to the most modern and accepted practice? W. H. C.

A.—You have raised a question over which there is considerable discussion, and the practice seems to be fairly equally divided. There are certain instances where the separate combustion chamber is preferable from an operating point of view, and others where it makes little difference, and therefore the single combustion chamber is to be preferred owing to less first cost. From the operating point of view, the chief consideration is draft. If it is necessary to fire the furnace very often, such as when running on forced draft

and at a high rate of combustion, the separate chamber is to be preferred. Of course every time that the furnace door is opened the draft is checked and the steaming capacity decreased. Now, if it is necessary to fire four times an hour, and you have but one combustion chamber, the draft will be checked eight times during the hour, and the draft must be shut off from each of the two furnaces whenever one of them is opened. This is bad practice because it always takes a minute or so for the fire to get drawing properly after the draft has been checked and turned on. As far as the fact of the cold air striking the tubes is concerned, it is always bad and the less you have of it the better, and with separate combustion chambers each tube will be subjected to the cold draft only half as much as with the single chamber. Your contention that the combustion is improved with the single chamber owing to the partially consumed gases from the freshly fired grate being mixed with the gases from the full fire, is a good one.

Summing up the conditions for two-furnace Scotch boilers, we find that the general practice is to use separate combustion chambers where forced or induced draft is installed and single chambers largely from reasons of decreased weight, first cost, etc., where natural draft is installed.

Q. 205.—Will you advise me from which fuel the most power may be obtained, kerosene or gasoline? S.

A.—The heating value of a fuel, which is what we understand you mean by "power," is stated in thermal units and that unit which is generally used in the British thermal unit (B. T. U.) which is the amount of heat required to raise the temperature of one pound of water at 39 degrees Fahrenheit, one degree Fahrenheit. The heating value of gasoline and its vapor is given as 21,900 B. T. U. and that of kerosene 27,500 B. T. U.

Q. 206.—Will you please inform me what the ratio between the evaporating surface and the production per day of a modern evaporator in actual practice is? D. C.

A.—This is a very difficult question to answer, for, in the first place, the conditions under which the evaporator is to run altogether govern this factor of heating surface, and, unless you specify more definitely it is impossible to come anywhere near the probable figure; and, secondly, different makers do not agree on the amount of surface for similar conditions. Evaporators are made in single, double, and triple effect, and in some cases quadruple effects are used. In these vapor from a high pressure is led to a second evaporator and used to evaporate the water in the second effect; similarly, its vapor is led to the third effect, and so on. The conditions of the heating surface, whether or not the tubes are scaly or whether there is a deposit of salt on them, etc., governs the amount of water evaported.

In the navy type of evaporator, which is used on many of the new government ships, one square foot of surface is credited with evaporating 20 gallons of water in twenty-four hours with steam pressure at 120 pounds and the evaporators connected singly. Thus, in the specifications for the battleship *Virginia*, three evaporators are called for to evaporate collectively 23,000 gallons of water in twenty-four hours and to have collectively not less than 1,170 square feet of surface; also, in the gunboat *Paducah*, there are specified two evaporators of a combined surface of 180 square feet which are to evaporate at least 3,500 gallons of water in twenty-four hours.

Q. 207.—Please give me through your Q. and A. the heating surface for a vertical water-tube suitable for triple expansion engine with cylinders 3, 5, and 8 inches diameter by 4 inches stroke, running at 400 revolutions by 5-8-inch cut-off on H. P. cylinder, the boiler pressure is to be 200 pounds. I wish to fit boiler for oil fuel burning. De B.

A.—There are two ways in which the heating surface may be figured for your engine: first, from calculating the cubic feet of steam used up to the point of cut-off per hour; second, by figuring up the estimated horse power, and assuming a certain efficiency of the engine. The processes are in brief as follows:

The capacity in cubic inches of the high-pressure cylinder up to the point of cut-off, or 5-8 of a stroke, is the area of the cylinder, $7.068 \times 2.5 = 17.67$ cubic inches. This space is filled with steam from the boiler twice in each revolution; thus, upon the up and down strokes, 800 times a minute, or 48,000 times an hour. Then reducing to cubic feet by dividing by 1,728, we have without allowance for the volume of the clearance space, as follows:

$$\frac{17.67 \times 48{,}000}{1{,}728} = 490.8 \text{ cubic feet per hour.}$$

We now assume that the steam pressure at the point of cut-off is 185 pounds gauge. At this pressure 1 cubic foot of steam weighs .44 pounds (this value can be found in any of the steam tables), therefore, the calculated number of pounds per hour is

$$490.8 \times .44 = 216 \text{ pounds.}$$

It is, however, probable that the steam will not be in a saturated condition at the point of cut-off. You can assume that it will be 95 per cent. dry. Also, the heating surface must be increased, for the feed water will probably be evaporated from a temperature less than the boiling point. Assuming that the temperature of the feed water will be 100 degrees, then to raise steam to 200 pounds pressure from this temperature of feed would require an extra amount of work to be expended, *i. e.*, coal burned. This amount may be also ascertained in the steam tables, and is called the factor of evaporation, which, under these conditions, is 1.171. Therefore, making the two corrections for quality of steam and evaporation factor, we have

$$216 \times 1.171 \times .95 = 266 \text{ pounds.}$$

In your type of boiler it will be safe to allow about 3 pounds of water evaporated per square foot of heating surface. Therefore, dividing this last figure by 3, we have 88.7 square feet of heating surface.

The second method requires first the horse power to be ascertained and is as follows:

The number of expansions of the steam from point of cut-off in the high-pressure cylinder to the full volume of the low-pressure cylinder is found by dividing the volume of the low-pressure cylinder, 205 cubic inches, by the volume of the high-pressure up to the point of cut-off, or 17.67 cubic inches, which is roughly 11 1-2. At this ratio of expansion, and assuming steam pressure at 185 pounds, it is found that the mean effective pressure referred to the low-pressure cylinder is 33 pounds, and the formula by which this is derived is as follows:

$$p_m = p_1 \frac{1 \times \text{hyp. log. } r.}{r}$$

in which p_1 = absolute initial pressure = 200 lbs.
p_m = mean effective pressure,
r = number of expansions = 11.5.

From steam tables it is found that for expansion of 11 1-2 the expression at the right hand = .3.

Then, $p_m = 200 \times .3 = 60$ pounds.

From this the back pressure of 5 pounds must be taken, assuming that you will run condensing, which leaves 55 pounds, which is the theoretical mean effective pressure. To reduce this to practice it must be multiplied by a card factor, which, for this engine, will probably be in the neighborhood of .6.

$$55 \times .6 = 33.$$

Multiplying now the mean effective pressure × the length of stroke in feet × the area of the L. P. cylinder in inches × the number of stroke, and dividing by a constant, will give the horse power as follows:

$$\frac{33 \times 1\text{-}3 \times 50.25 \times 800}{33{,}000} = 13.4 \text{ H. P.}$$

Assuming that your engine will require 20 pounds of steam per horse power per hour, the total steam per hour will be 268.

With the assumptions in these two cases the results come out very closely, and you can safely figure on 90 square feet of heating surface giving you all the steam necessary under good working conditions in a well-designed boiler for this engine.

Q. 208.—Will you kindly tell me what changes are necessary to a two-cycle gasoline engine to adapt it to the use of kerosene? Why is the jump spark generally not used on marine motors?
R. E. B.

A.—The difficulty in the way of using kerosene in place of gasoline is that kerosene does not volatilize as readily as does gasoline, and therefore does not so readily form an explosive mixture with air, which may be ignited by a spark. One form of kerosene explosive engine which has given very good satisfaction and is of the two-cycle type, compresses the air before the kerosene is taken in. At the end of compression, which is not over 40 pounds, the kerosene is sprayed in through a very fine nozzle, and the charge is ignited by an incandescent hollow ball placed at the top of the cylinder. Some makers are now fitting special feed appliances which permit kerosene to be used as a working fluid.

The answer to your query on Jump Spark is given in A. 202.

Q. 209.—Will you please advise if you consider a speed of 720 revolutions per minute in a four cycle 10-horse power double-cylinder engine the most economical and efficient for driving a cabin boat of say 35 feet length and 8 feet beam with torpedo stern.
W. D. L.

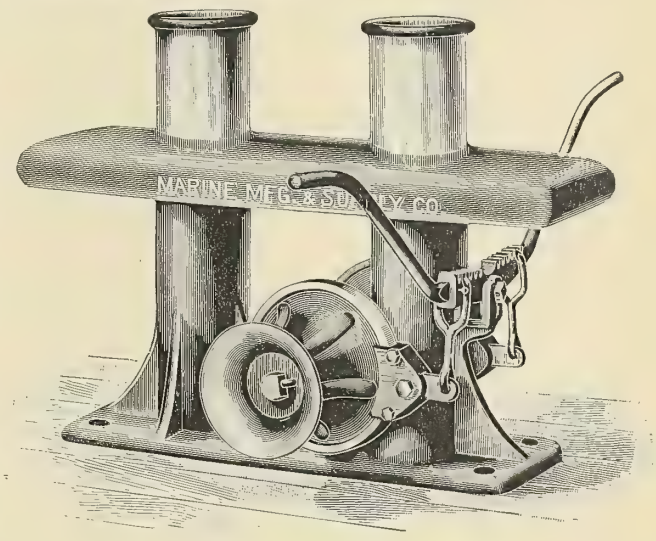
A.—The above speed will be all right. The engine will run more economically than at a slower speed. It may require a wheel with less pitch than a slow-speed motor, but will run the boat faster and at less cost.

New Turbine Manufacturers.—The Allis-Chalmers Company, Chicago, Ill., makes formal announcement of its purpose to engage in the manufacture of steam turbines, hydraulic machinery, gas engines and electrical machinery. The company has exclusive license from the Steam Turbine Advisory Syndicate of England to use its horizontal turbine for the United States, Canada and Mexico, which is a type much similar to that of Parsons, of England, and Brown-Boverie, of Switzerland.

ENGINEERING SPECIALTIES.

Iron Towing Bitts.

The superiority of the iron towing bitt over the more familiar wooden bitt is such that if clearly understood it is doubtful if the latter kind would be used at all. In the first place, the iron towing bitts are much stronger and more durable; then as they do not pass through the deck as the wooden bitts do, the space below is entirely clear and may be utilized for tanks, storage, or other purposes. The strains which come upon the bitts are such that to keep the deck tight around wooden bitts is practically impossible, which results in deterioration of the deck and in leakage. The iron bitts are bolted through the deck directly to the beams, and, when a reinforcing steel plate is placed under them, riveted to the beams, the construction is very strong and most satisfactory.



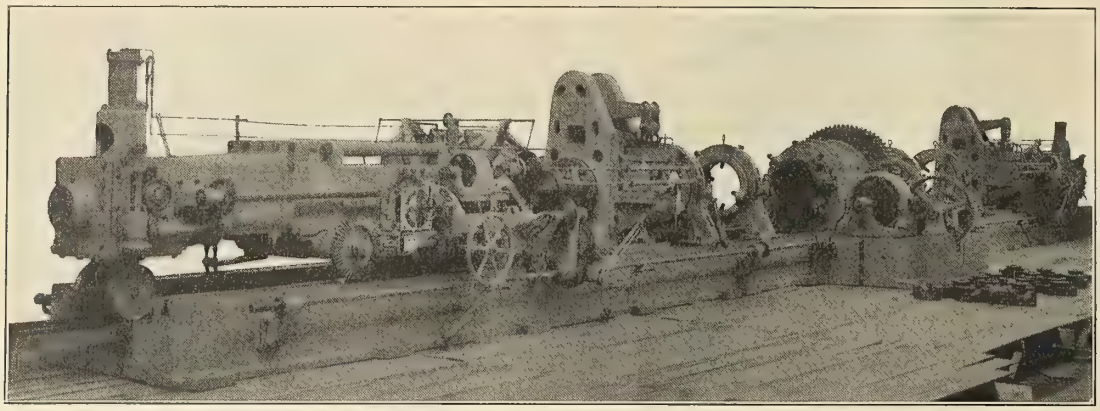
IRON TOWING BITT WITH PUMP BRAKE WINDLASS.

The double forward bitt here shown is made by the Marine Manufacturing & Supply Company, 157 South street, New York, N. Y. It is made in two sizes, 41 and 43 inches high over all, and weighing 1,800 and 2,400 pounds respectively. A special feature, as will be noticed, is the windlass which is located at the base in a space otherwise useless. The windlass is a pump brake friction windlass operated by hand.

Iron towing bitts are also made for mounting at the sides and at the stern, and the side bitts are so designed as to become an integral part of the vessel's frame, and thus add materially to the strength of the bulwarks.

Featherweight Air Pumps.

The Featherweight air pump is the type supplied the Russian Admiralty for the battleships *Alexander III.*, the *Oreal, Souvaroff*, and *Slava*. These pumps are built on the so-called suction valveless principle, as previously described in these columns, and are similar to those installed on several of the United States battleships. It is stated that on the official trial of the *Missouri* these pumps did their work with an expenditure of less than one-seventh of 1 per cent. of the I. H. P. of the main engines, and yet maintained a vacuum of over 26 inches.



14-INCH HYDRAULIC BORING LATHE SPECIALLY BUILT FOR BORING GUN FORGINGS AND MARINE SHAFTING.

14-Inch Hydraulic Boring Lathe.

The machine illustrated herewith and made by the Niles-Bement-Pond Company, 136 Liberty street, New York, N. Y., is intended to bore gun forgings, marine shafts, and ingots generally. It will take in a shaft 60 feet long, 30 inches in diameter, and bore a hole out of the solid 12 inches in diameter the full length, or 14 inches for short length.

Two boring bars are used, one at each end, while the work is being held in a hollow spindle or revolving chuck. Two, revolving, ring steady rests on each side of the center chuck support the work. The feed pressure required to do such extremely heavy work is so great that it becomes impractical to feed by rack and pinion or screw. For this reason the boring bars are fed in by hydraulic pressure. The boring bar itself is clamped in a head by means of hydraulic pressure, in addition to lever and toggle joint. The hydraulic pressure against the piston is 720 pounds per square inch, giving a total pressure of 200,000 pounds against the piston.

It is obvious that an arrangement like this would allow the tool to gouge into the work should the metal be soft, and, generally speaking, would not offer any means of control of the feed. In order to provide for this control, the rear end of the piston, that is, the end projecting backward from the cylinder, is cut as a very steep screw. A nut revolving on this screw has a worm wheel with very steep pitch cut on its outer circumference. The angles of the screw and the worm are so chosen that the pressure against the piston will be able to revolve the nut, and the movement of the nut will be able to revolve the worm, but a relatively small amount of resistance on the worm will entirely check this movement. This amount of resistance is provided by ordinary feed mechanism taken from friction discs, which have the necessary change gears, etc., to enable the operator to get any feed desired. It will be seen, therefore, that the hydraulic cylinder furnishes the pressure and the feed mechanism furnishes the amount of feed, but that the feed mechanism is never subjected to the heavy strains due to the exceedingly heavy work to be done on this machine.

The illustration shows the drive of this machine. It is driven by a 100 horse power Westinghouse motor, 220 volts. A motor of this make and size always allows of some speed variation by means of field control. The range of speed is increased by change gears, which are also clearly visible in the illustration. The piece to be bored is chucked by means of eight set screws, 3 1-2 inches in diameter, on each side of the machine.

The feed is taken from the last driving shaft, and is transmitted to the two cylinders by means of the long shaft running alongside and in front of the bed. This shaft is supported by drop bearings and is made in three pieces coupled together. Change gears and friction discs give a wide range of feeds.

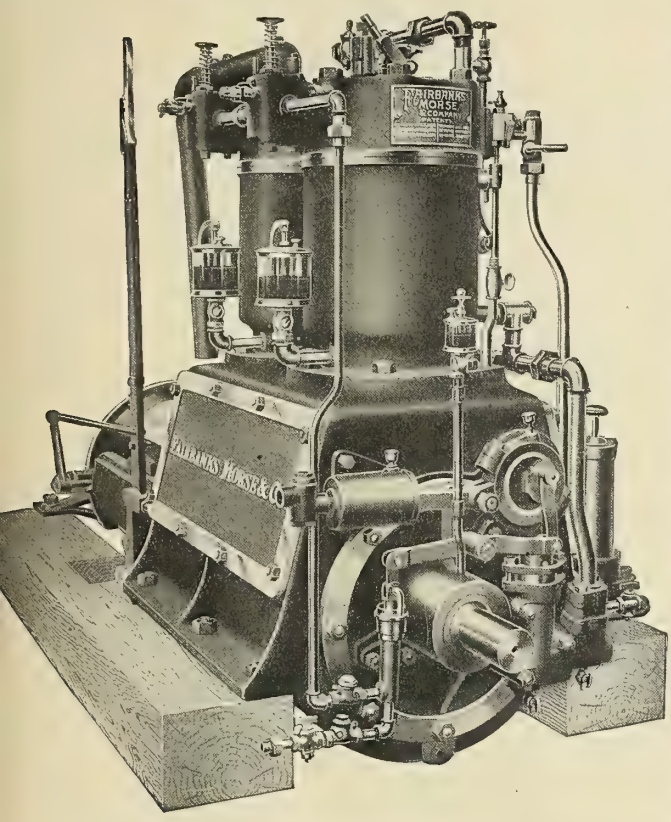
A hand feed is provided for by means of hand wheel. Before using this hand wheel, friction discs and feed driving shaft are disconnected by means of hand-wheel. A 5-H. P. motor gives a fast motion to a train of gearing, whereas the feed mechanism gives a slow motion to this train. Clutch-levers throw in either one or the other, and thus give either a slow feed or a quick traverse of 10 feet per minute to the piston, and, if the cylinder is clamped to the bed, also to the clamping-head, or, if the clamping-head is clamped to the bed, it gives this quick traverse to the cylinder. This quick traverse is really gotten by means of hydraulic pressure in the cylinder, and the small motor only regulates the speed. A hand-wheel gives adjustment to the piston and clamp-head, or to the cylinder, should this latter be clamped to the bed.

The train of gearing moved by the motor can be connected to the cylinder mechanism, or it can be connected to the shaft, which, by means of suitable gearing, drives a grooved roll, which is not visible in the illustration, but which is held in a floating frame inside of the rear part of the cylinder casting. This floating frame carries the hydraulic cylinder, the piston of which is connected to this grooved roll while the cylinder casting is connected to two other rollers under the bar. By admitting water in this cylinder the inner boring-bar is clamped between the rollers, and by moving the grooved roll a quick traverse motion is imparted to this inner bar.

The mode of operating this machine is to force 4 feet of the boring-bar into the work. By that time the clamping-head is up to the work and 4 feet distant from the cylinder. The quick traverse is then brought into play and the clamping-head is pulled back until it comes up

to the cylinder. The inner boring-bar is then pushed 4 feet further forward and the boring-bar is once more forced into the work another 4 feet. This alternate action of forcing the bar into the work and drawing the clamping-back so as to take a new grip is repeated until the center of the work is reached.

The piping for the different cylinders is at the rear of the machine supported in brackets or rollers where the piping is sliding. There are handles for operating the various valves both on the front and rear sides of the machine.



4-CYCLE MARINE GASOLINE ENGINE.

Gasoline Marine Engine.

For a number of years Fairbanks, Morse & Company, Chicago, Ill., have been building extensively gasoline engines up to 10 horse power, but of late years the company has added new sizes, the largest being 150 horse power. These engines are all of the four-cycle type with either two, three, or four cylinders, depending on the horse power of the engine. Each cylinder is a separate casting and water jacketed at sides and on head. They are mounted on inclosed crank case with hand hole and removable plate at side, thus all the bearings and working parts within the crank case are accessible. Each bearing and working part is positively lubricated from a sight feed lubricator, and, in addition, the pistons dip into oil rings, distributing oil to the cylinder walls, and splash lubrication in the crank pit may be obtained if desired.

The admission and exhaust valves are on the head of the cylinder. Each cylinder is fitted with a special gasoline fed reservoir, which is fed by a pump, direct connected to the engine, with gasoline drawn from the main tank. Thus there is but a small supply of gasoline at the engine in the reservoir, and the feed is shut off when the engine stops running.

It will be seen from the cut herewith of engine with flywheel removed that a water pump and an air pump, both operated from the side shaft of the engine, are conveniently attached to the base. The water pump is used for supplying circulating water for cooling the engine cylinders. The air pump supplies air for operating whistle for signalling. The starting gear consists of a hand charging air pump which pumps the first charge into one of the cylinders. This charge is then ignited by means of the improved and patented electric igniter. The explosion of this first charge starts the engine in motion, and the other cylinders then draw in their charges and explode them in succession, putting the engine rapidly and easily into full motion. The engines are fitted with a governor so that there is no chance of racing when the screw is out of water.

Reversal of the engine is accomplished by a friction clutch arranged in an extended casing at the after end of the engine base, and controlled by a lever seen at the left of the illustration. When forward motion is desired the lever is thrown forward and couples all parts rigidly together, so that the gear travels in same direction as the engine shaft, acting as a balance wheel in addition to the flywheel. No gears are in contact when the lever is in this position. When thrown aft the lever throws out the clutch connecting the reversing gears and causes the propeller and shaft to rotate in reversed direction. The intermediate position of the lever allows the engine to run free. The blades of the propeller are so arranged that the pitch may be set at any desired point.

Conveniently placed either on the engine or at any other desired point, is a controlling lever acting on the engine governor, making it possible to run the engine at any desired speed between its mimimum and maximum speeds. This device is especially valuable when making a landing or when it is desired to run at slow speed.

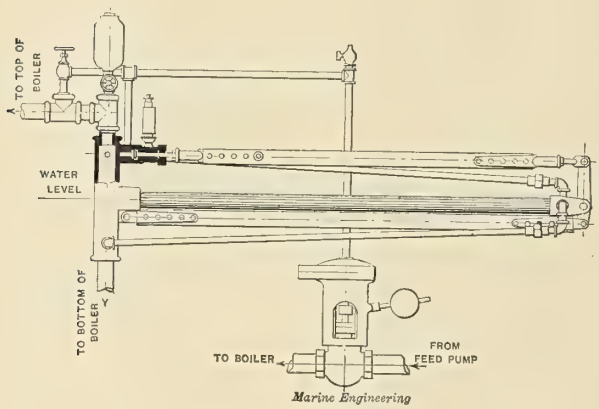
This company has brought out a marine engine which in all important respects resembles the gasoline engine herewith described, but which uses kerosene oil, the only difference being a slight modification in the feeding device attached to each cylinder. No doubt this feature will recommend the engine to many who have desired to use other power than steam, yet do not care to intall such an inflammable fuel as gasoline.

Feed-Water Regulator.

A feed-water regulator has been placed on the market which has for its actuating principal the expansion and contraction of copper pipe, which is always positive in action. The apparatus, known as the Buffalo Feed-Water Regulator, made by Robert Learmonth, 100 White Building, Buffalo, N. Y., is a device guaranteed to maintain water at a level varying only two or three inches in height regardless of the pressure of steam in the boilers, so long as there is any steam present. The amount of heat in steam is much greater than that in water under the same pressure, and regulation in this device is accomplished by the expansion or contraction

of a copper tube connected with the boiler and placed horizontally at the level of the water line, due to the tube being filled with either steam or water.

When the water in the boiler is at its normal level, the tube is filled with water, cooling it and causing it to contract and become shorter, and when the water is below the normal level in the boiler the tube is filled with steam, causing a rise of temperature in the tube, making it longer. This lengthening and shortening of the copper tube gives motion to a small valve, shown in the upright column, which increases the pressure on the regulating valve, or releases it, as the case may be, to supply the water needed to maintain the desired quantity in the steam boiler.



EXPANSION FEED WATER HEATER.

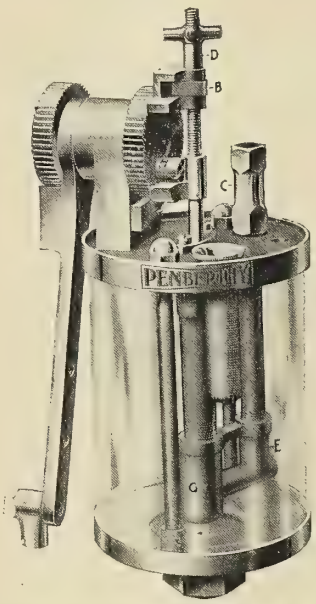
The device will regulate the water supply in any of the following ways: First, by throttling the steam supply to the pump; second, by shutting off the water from going into the boiler, and third, by allowing the surplus water to escape or flow back to the pump. The device not only regulates the supply of water but it also gives warning when the water level is low, by the steam in the pipe blowing a small whistle, thus there is no danger of the engineer forgetting to look after the water supply of the boiler. The manufacturer guarantees each regulator to work perfectly well or he will take it back and refund the money.

Force Feed Lubricator.

One of the latest inventions in this class of lubricators is shown in the annexed cut. Its principal features are, first, the two ratchets, one of which is used to drive the plunger, while the other acts on the plunger itself, and secondly, the location of the valves which are in the center of the oil reservoir.

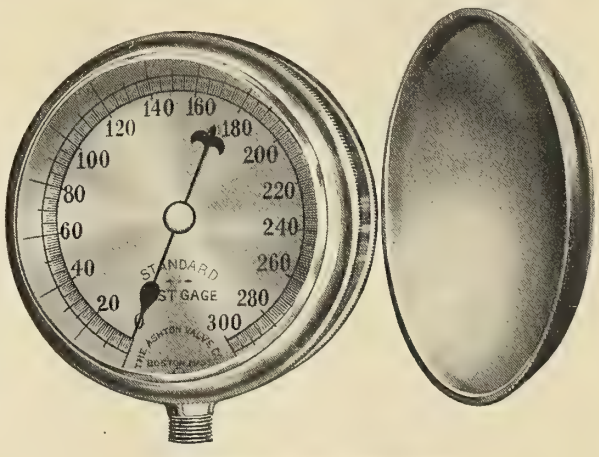
The advantage of two ratchets is that they are interchangeable, and as the wear only comes on the outer ratchet to which the lever is attached, when one of the ratchets is worn to such an extent that the "dog" will not hold, it can be replaced by the ratchet acting on the plunger, and the life of the lubricator thereby doubled. As the ratchet is the first thing to wear out, this device will be appreciated by engineers.

The advantage of having the valve and feed at the center of oil reservoir is that they cannot be affected by changes of temperature, and it will therefore feed oils very difficult to feed through hydrostatic cups.



LUBRICATOR OF THE FORCED FEED TYPE.

Closing jaws of lubricator with the nut *B* increases the feed, opening decreases the feed. When the proper amount of oil is being fed, screw down the lock nut *D* to hold rigidly in place. Extra oil can be had by screwing down the nut *B* and operating the plunger by hand. The cup can be cleaned from a hole in the bottom designed for that purpose. This cup is manufactured by the Penberthy Injector Co., of Detroit, Mich.



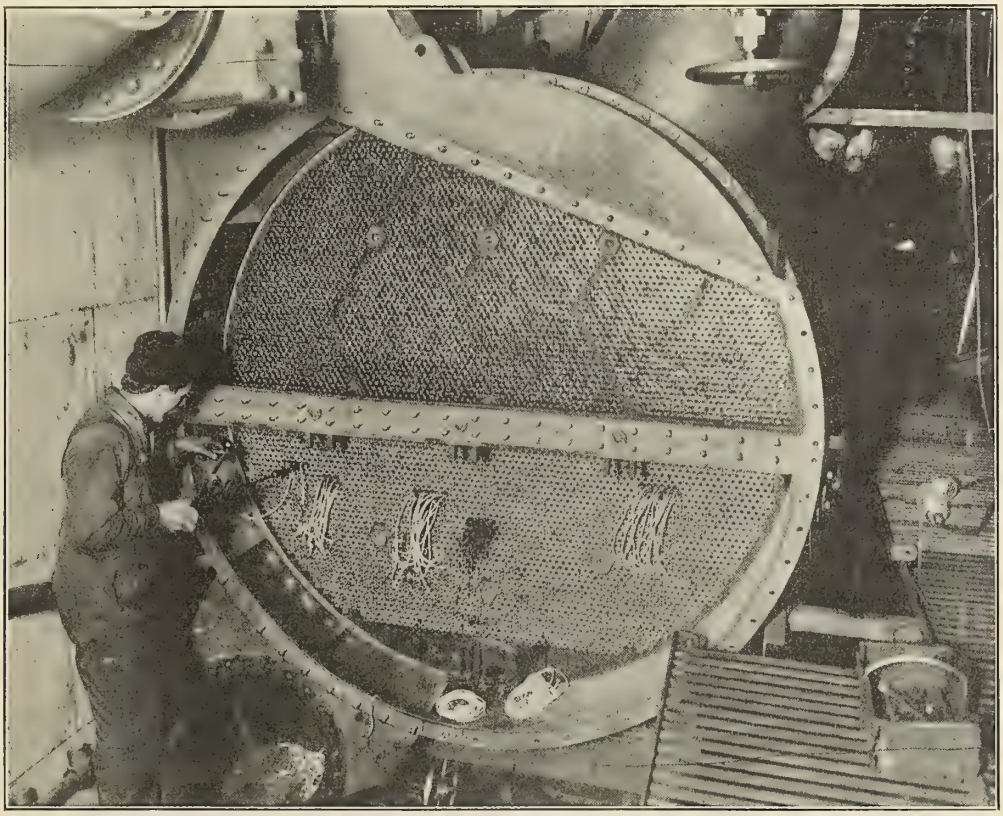
AN ENGINEER'S SMALL TEST GAUGE.

Pocket Test Gauge.

To meet the demand for a neat, light, and accurate test gauge of a suitable size, and so constructed that it can be carried in the pocket, without danger of injury, the Ashton Valve Company, 271 Franklin street, Boston,

Mass., has brought out the Standard pocket test gauge shown in the cut on page 196. It is particularly designed to meet these requirements as it is made with a beveled plate glass front and fitted with a cover to insure protection.

This gauge, like other Ashton gauges, is made with a spring of solid drawn seamless tubing with a non-corrosive movement, and is the best that high grade material and workmanship can produce. The gauge is of the 3-inch size with the dial graduated for any pressure up to an including 500 pounds. It is made in full nickel plate and weighs when completed with cover about one pound.



A LABOR SAVING MACHINE FOR PACKING THE TUBE ENDS OF SURFACE CONDENSERS.

Machine for Packing Tube Ends of Surface Condensers.

A little device herewith illustrated bids fair to save a great deal of labor in any machine shop were surface condensers are made. It has been brought out by Mr. John Schlosser of Cramp's Shipyard, and is devised to pack in a very short time the tube ends of surface condensers, which operation has heretofore been a long and tedious one. The device consists of a small tool used in connection with an ordinary bit brace, breast drill or with a small pneumatic drill. With this tool a corset lacing can be wound in place it is claimed in less than half the time required by the old method, and insures far better results.

Mr. Schlosser contracted for packing the condensers of the new cruisers *Pennsylvania* and *Colorado,* nearing completion, and established a record of packing 1200 tube ends in five and one-quarter hours, and three thousand tubes ends in fifteen hours. On the whole job, which amounted to 11,360 tubes or double that number of ends, he effected a saving for the shipbuilding company of over 60 per cent. of the former prices paid for such work.

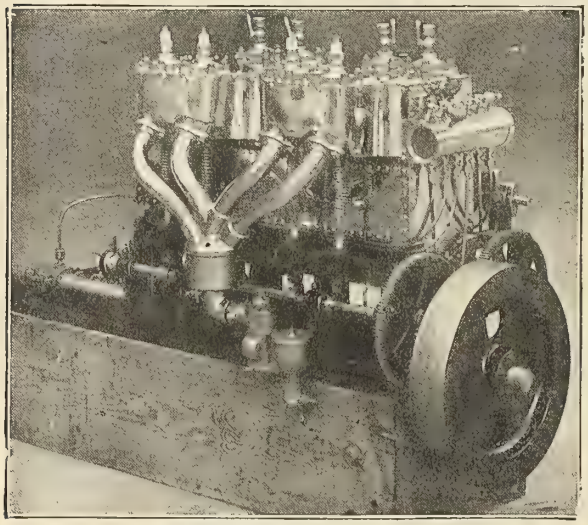
The tool has been placed in the hands of Matteson & Drake, 706-707 Bourse, Philadelphia, as sole manufacturing and sales agents for the United States, who in turn will arrange for distributing agencies in the different cities of the Atlantic and Pacific seaboards, for handling the tool.

New Marine Gasoline Engine.

To meet the demands of a strictly marine engine for small power boats, there has recently been placed on the market by the Yacht, Gas Engine, & Launch Company, Bourse Building, Philadelphia, Pa., the Crown yacht engine illustrated on page 198. It is claimed that marine steam engine lines have been followed as far as possible in the design of this gas engine. Best grades of steel, bronze, and cast iron have been used. In the 10-horse power size, two cylinders are supplied, and for 20-horse power, the two 10-horse power units are bolted together. The cylinders are of the best gray iron cast in pairs without a water jacket and with solid heads. The pistons are fitted with three rings and have special provision for lubrication. The bedplate is a single casting and supports the cylinders by means of eight steel

stanchions. The main journals have specially large bearing surface and are poured with a combination of government bronze and Parson's white metal which, it is claimed, has a very long life.

The water jacket is made of Victor non-corrosive silver metal, which is non-galvanic and much lighter than cast iron, the circulation is around the valve chambers over the top and around each cylinder. The crank shafts are open hearth steel and the connecting rods are of forged steel milled to I-beam section and fitted with government bronze crank pin ends and phosphor bronze piston ends. The cams are of drop forged steel. Cast iron valves are used and a tapered plug is placed over each, so that the valve may be easily taken out if necessary. Steel rollers are placed in the valve stem guides to overcome the friction due to side thrust of the cams.



NEW TYPE OF MARINE GASOLINE ENGINE.

Each piston has an oil pipe leading to each side, and each main bearing has a pipe coming from a multiple oiler, while the connecting rods are fitted with brass rollers. The Holley carburetter and Herz commutator and jump spark are fitted. The weight of the 10-horse power engine is but 500 pounds completed with reversing gear. The engine is so designed that any part can be removed without disturbing or dismantling any other part.

The "Patternmaker."—A new monthly magazine has been issued by the Iron and Steel Press Company, Rose Building, Cleveland, O., and called the *Patternmaker*. As the name implies, the paper is to be devoted to the whole patternmaking trade, including the shop owners, manufacturers, foremen, and workmen, and will deal with all phases of the business, including both wood and metal patternmaking. Mr. Henry M. Lane, the editor, promises to present articles describing new appliances, foundry conditions, current practice, etc., and it is intended to make the magazine a "direct bond between the manufacturer of patternmaking supplies and machinery, and the users." The first issue is that of March and contains 38 pages of good reading matter and an equal amount of advertising.

TECHNICAL PUBLICATIONS.

A Manual of Marine Engineering. By A. E. Seaton. Size, 6 by 9 inches. Pp. 707, with 230 figures and illustrations in the text. London and New York, D. Van Nostrand Co. Price, $6.00.

This work has long been a standard in the field of marine design, and since the appearance of the first edition in 1883, it has held its place and steadily grown in favor as successive editions have appeared. This edition is the fifteenth, and represents a more complete and thorough revision than many of its predecessors, and constitutes, according to the author's preface, practically a new book. As stated by the author in his earliest preface the fundamental purpose of the work was in effect to provide aid to the designer of marine machinery in the application of scientific principles to the problems which he is called on day by day to solve, and to show the general condition of the best practice in this field of engineering work. This aim has been consistently held in view throughout, and the gratifying reception which the work has been accorded is an indication of the real need which has existed for such a work.

The book is divided into twenty-six chapters which, as a whole, are intended to cover the general field of marine practice, with especial reference to the designing aspect of the work. Naturally, however, the book contains a large amount of descriptive matter and general discussion, such features being a necessity in a book treating the general subject of design. Again the discussion of design necessarily appears under two aspects, the determination of general characteristics and proportions, and the determination of detail dimensions and of structure. The former has reference to the fulfillment of the general conditions, regarding capacity, efficiency, &c., while the latter has special reference to the provision of strength and other engineering qualities as provided by the various materials of construction best suited to the special requirements involved.

The first chapter is chiefly concerned with the history of the development of the various types of marine engines which have appeared prominently since the early beginnings of steam navigation. In the following chapter the author gives a general discussion of horse power, both nominal and indicated, together with a brief presentation of the general theory of the steam engine and of its various efficiencies, thermodynamic and mechanical. The most valuable feature of the chapter is found in this general discussion of the steam engine, and of the various losses of useful effect between the boiler and the propeller shaft.

The following chapter deals with the subject of resistance and propulsion and the powering of ships. This important chapter has reference to the general purpose of the book in so far as it has to deal directly with the power required to obtain a given speed, and also with the propeller which is intended to absorb this power with the highest obtainable efficiency, and to develop thereby the thrust necessary for the propulsion of the ship.

The following three chapters deal with the marine steam engine with reference to type, space required in the ship, principles of economy, operation under the prevailing conditions in marine practice, and with

various other aspects of the steam engine not coming under the direct head of structural design. Then follow ten chapters dealing with the general subject of the design of the engine considered as an engineering structure, and involving a discussion of the principles which should govern the determination of the most suitable dimensions for the various structural items of the machinery. These chapters include also reference to the chief items of auxiliary machinery, to problems of valve gear design and to the valve gear diagrams in common use for the solution of such problems. One entire chapter of this section of the work is given to the design of the screw propeller and paddle-wheel as instruments of propulsion, and various practical rules of design are given, both with reference to the determination of structure and of general dimensions.

The following five chapters deal with marine boilers in the same comprehensive manner. Fuels, combustion, natural and forced draft, the evaporated capacity of boilers, the general design and proportion of Scotch boilers, descriptions and discussion of the leading varieties of water tube boilers, boiler mountings and fittings; these various items receive due consideration and extended reference is made to the various rules and regulations of registration societies regarding the details of boiler design and construction. These chapters are followed by a chapter on the erection of machinery on board ship, and including descriptions of various items of auxiliary machinery and special equipment.

Chapter xxiii, which follows, contains matter practically new in the present edition, and dealing with the weight of marine machinery in its various aspects and relations, and with the considerations which may influence its amount in any given case. A feature of special value in this chapter is found in a table giving the safe working stresses as proposed by the author for all classes of materials and according as the stress to which they are subject is steady, intermittent or alternating. The experiences of recent years in high speed practice have impressed on engineers the necessity of some distinction between working stresses with especial reference to the character of the stresses involved, and designers will gladly welcome these suggestions as to safe working limits from one with so wide an experience as the author of this work. Of especial note in this table is the distinction between intermittent and alternating stresses. The former are defined as stresses always acting in the same direction but varying in amount or intermittent in character, while by the latter are implied stresses alternating in direction or character.

The following chapter on inertia forces and balancing is also essentially new in the present edition. This general topic is likewise one which has come largely to the front in the past few years, and no marine design of importance can be considered complete which does not include an examination of the inertia forces developed, and of the best methods for effecting a dynamic balance of the moving parts of the engine. A general discussion of the topic is given, with rules for analysis and for the determination of the most practicable conditions for reducing the resultant inertia forces to the smallest possible values. Naturally vector processes are recommended for the combination of the various inertia forces for a series of moving parts, and the general principles of such analysis and combination are clearly presented and discussed with reference to the cases most commonly met with in such problems.

The following chapter on the materials of engineering has also been greatly extended in the present edition, and a large amount of most valuable information is given with reference to the various materials at the disposal of the designing or constructing engineer. The following and last chapter is new in the present edition, and deals with the general subject of oils and lubrication. This chapter will be welcomed as dealing with a topic too commonly overlooked in the literature of marine construction, but none the less of the highest importance both for the designing and for the operative marine engineer.

Following this chapter are found some 80 pages of appendix, consisting for the most part of the rules of the various registration or classification societies and forming for the designer a most convenient collection of these various sets of rules and regulations.

We have given but inadequately a general sketch of the contents of this extended treatise, with special reference to the features which are new in the present edition. Much of the work naturally remains essentially as in previous editions. Some features are quite out of date and might better have been omitted, as for example reference to Rankine's augmented surface method for powering ships, and some portions of weight and general engine and boiler data in chapter xxiii. Again the absence of any adequate discussion of the application of Froude's law of comparison for powering ships, or of reference to the experiments of Mr. R. E. Froude relating to screw propellers or to the methods of design based thereon and devised by Barnaby and others, may be noted as somewhat surprising in a work otherwise so comprehensive and so exhaustive in many directions. As a whole, however, the book stands conspicuous in the field of engineering literature, and has well deserved the wide and long continued favor with which it has been received through the many editions from the first. The present edition marks a decided advance over its predecessors, and may be most cordially commended to the profession as a safe and conservative guide in the study of the many problems which arise in the broad field of marine design.

The Factory Manager and Accountant. By Horace Lucian Arnold (Henry Roland). Size, 6 1-2 by 9 1-2 inches. Pp. 431, with numerous figures and forms. The Engineering Magazine, New York and London. Price, $5.00.

This book is an expression of the general appreciation which the industrial world has come to have in recent years regarding the value of carefully studied systems of cost and commercial accounting as essentials of good engineering and business practice. The book comprises descriptions of several complete systems of factory accounting, with reproductions of the blanks and forms employed, each one having complete specifications as to size, color, material, arrangement, exact function, etc.

The descriptive matter is furthermore given in such detail as to show the purpose and complete function of each form with its relation to the others employed, so that a careful study of these systems will serve to give to the reader not only a comprehensive idea of the

modern methods of cost and commercial accounting for industrial engineering purposes, but also specific suggestions and information of value for particular cases which may be under consideration. The fundamental purpose of a cost accounting system is to furnish an answer in detail to any question which may arise as to the cost of the production and marketing of an industrial article, as dependent on raw material, manufacturing processes and marketing, with its due share of fixed charges for interest, insurance, depreciation, engineering and salary charges, etc., and all in such form as to give answers to such questions with the minimum demand for time and with the maximum adaptability for grouping items of various kinds in various ways for purposes of comparison and of study with reference to increased economy of future production.

The present book goes far toward showing how many or most of these various demands may be realized in various kinds of industrial work, and its careful perusal is commended to all who may have dealings with problems of this character.

SELECTED MARINE PATENTS.

750,322. BUOY FOR SUNKEN VESSELS. JOSEPH F. TRIBBLE, NORWICH, CONN., ASSIGNOR OF ONE-HALF TO AGNES V. PEABODY, WORCESTER, MASS.

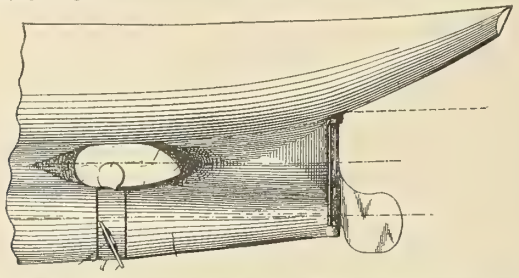
Claim.—1. In a buoy for sunken vessels, the combination of an airchamber, a chamber containing a reel with cable wound thereon and separable from said air-chamber, means for detachably securing said air-chamber and said reel-chamber together, with the axis of said reel-chamber coincident with the axis of said air-chamber. One claim.

750,533. JET PROPULSION APPARATUS FOR VESSELS. SEYMOUR GEORGE, PITTSBURG, PA., ASSIGNOR OF ONE-HALF TO CHARLES FRANCIS HARRIS, PITTSBURG, PA.

Claim.—1. In a jet propulsion apparatus for vessels, the combination with a rotary pump and means for operating the pump, of a jet mechanism having a discharge-pipe connected to the pump and provided with a siphon which extends considerably above the normal water-line of the vessel. One claim.

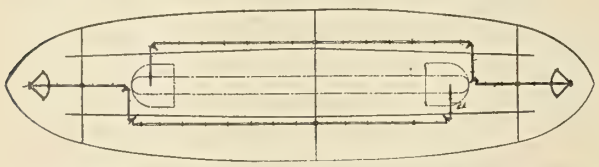
750,812. OAR-LOCK. ARCH D. COLLINS, LAWTON, VA. One claim.

751,158. PROPELLER-SHIP. CARL J. H. FLINDT, HOBOKEN, N. J.



Claim.—1. The combination in a ship having a rudder at its stern, of a hull, a propeller having blades and carried by the hull at its rear but at a distance considerably forward of the rudder; an opening through the hull to admit the passage of the propeller-blades from one side thereof to the other, the walls surrounding such opening having guide-faces projecting generally in the direction of flow of the water incident to the movement of the propeller-blades. One claim.

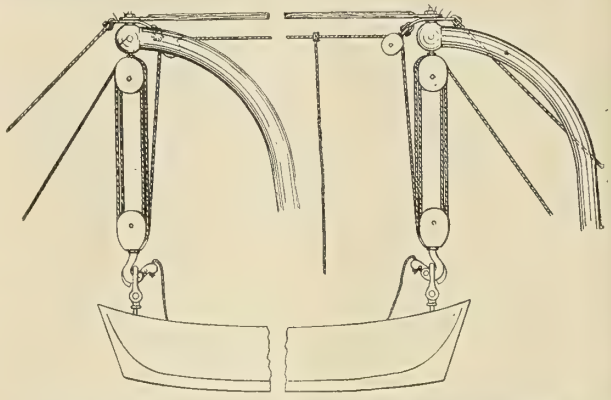
752,086. MEANS FOR LOCKING OR UNLOCKING RUDDERS. ALEXANDER J. MACLEAN, NEW YORK, N. Y.



Claim.—1. In rudder locking and unlocking means, the combination with a rudder and a horizontally-movable frame connected therewith and embodying a curved plate containing an opening, of a bolt repressed by said plate at either side of the opening, but adapted to enter the latter and lock the frame when the rudder is in a central position.

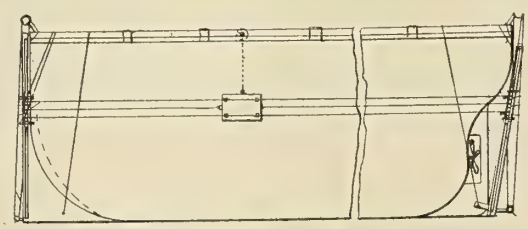
2. The combination with a boat and its rudder, of a horizontally-movable part connected with the rudder, a bolt repressed by said part when the rudder occupies a central position, said horizontally-movable part adapted to become engaged and locked by the bolt when the rudder is in a central position, and connections extending to a relatively remote point on the boat for operating the bolt. Three claims.

751,205. BOAT-DETACHING APPARATUS. JAMES R. RAYMOND, BAYONNE, N. J.



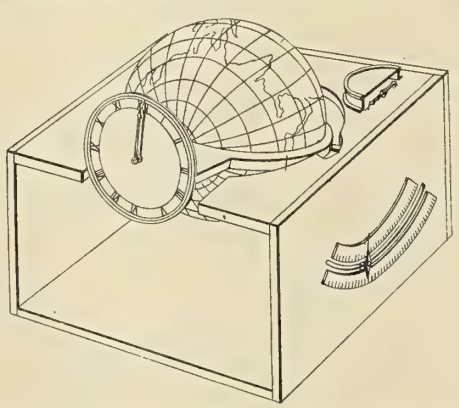
Claim.—1. In boat-detaching apparatus, the combination in the tackle-hook which engages a shackle on the boat of a body part, a weighted bill pivotally connected thereto, and a projection on said body part adapted to prevent the shackle from jumping back on said body part. Six claims.

752,142. SHIP-CLEANING DEVICE. EDWARD COLE, NEW YORK, N. Y. FILED JUNE 13, 1900. RENEWED JULY 21, 1903.



Claim.—1. In a ship-cleaning device, the combination of a scraping mechanism, a vertically adjustable and longitudinally-extending suspending means adapted to remain stationary while the scraping mechanism travels over the same, and an adjustable, vertical suspending means adapted to travel longitudinally with the scraping mechanism. Eleven claims.

752,717. NAVIGATOR'S POSITION-INDICATOR. JOHN B. SMITH, VALDOSTA, GA.



Claim.—1. The combination of a terrestrial globe mounted for adjustment to position corresponding to the relative position of earth and sun, and an opaque body disposed in proper position relative to the globe for casting a shadow thereon to indicate the location of the instrument at the time the observation is made. One claim.

752,670. PROPELLER. EDWARD D. HAMILTON, VANCOUVER, WASH.

Claim.—1. The combination with a shaft having dovetailed mortises therein, of a hub having on the inside tenons fitting said mortises and on the outside similar dovetailed mortises, and blades having bases fitting the mortises in the hub. Two claims.

INDEXED

Marine Engineering

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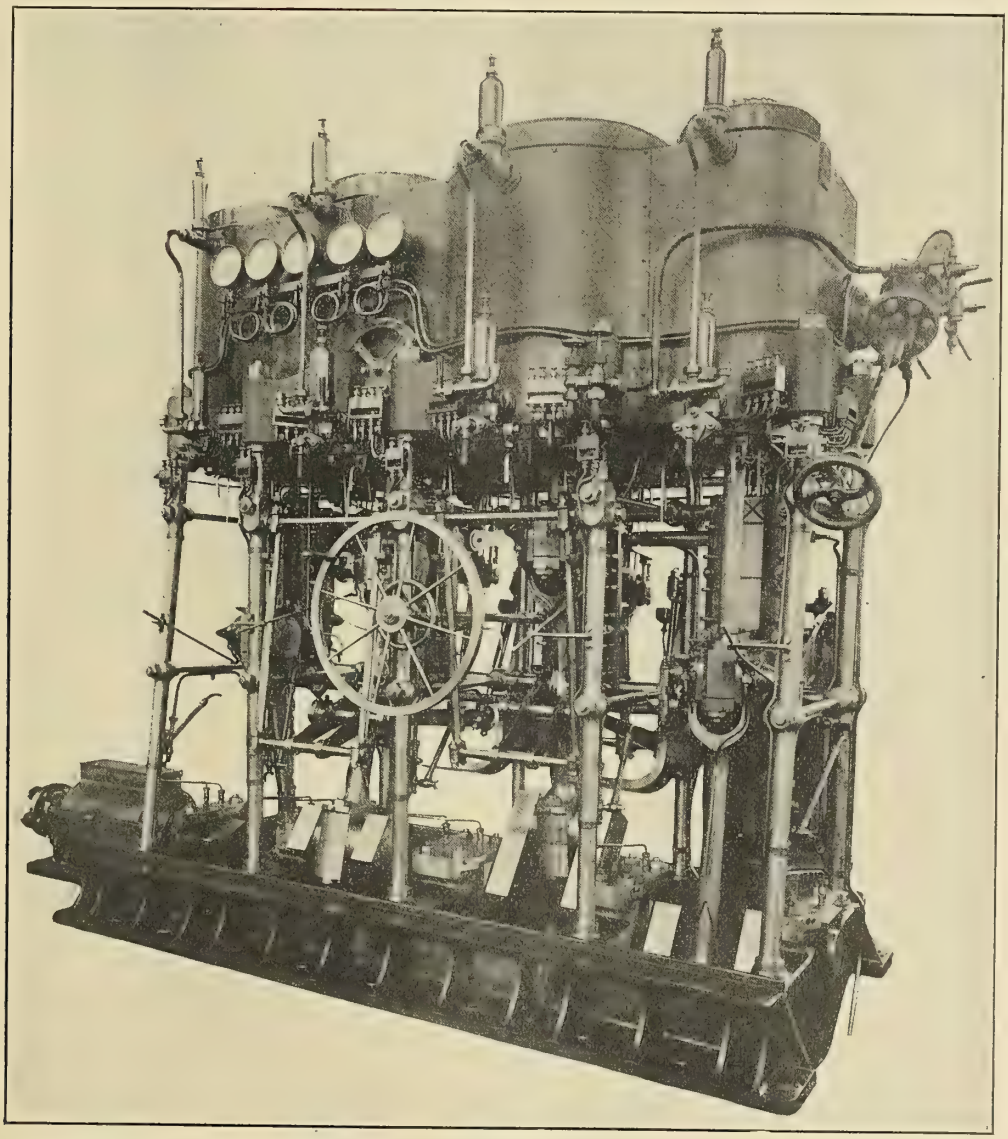
MAY 3 1904

JAPANESE IMPERIAL YACHT HATSUKAZE.

The steam yacht *Hatsukaze* was built, furnished and engined by Messrs. Mitsu Bishi Dockyard and Engine Works, Nagasaki, Japan, to the order of Baron Iwasaki, the owner of the establishment, and presented to his Imperial Highness, the Crown Prince, as a souvenir of his Highness visit to the works in 1900.



FRONT VIEW OF QUADRUPLE EXPANSION 230 I. H. P. ENGINE FOR JAPANESE IMPERIAL YACHT HATSUKAZE.

The vessel is built on the composite principle, although a departure is made in the construction from the general rule, the framing of the vessel being of wood, except in the way of saloon, where the frames are of angle steel, galvanized. The center girder, which extends from the stem head to the extreme end of stern, is built of steel plates and angles, the floors, which are also of steel, are riveted to this girder. The

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bulkheads, stringers, tie-plates, cabin sole, and beams are of steel, as also boiler and engine seats and coal bunkers. All steel and iron work is galvanized throughout.

In many respects she is unique and her appointment and equipment are very complete; her principal dimensions are as follows:

Length over all	109 ft. 0 in.
Length between perpendiculars	90 ft. 0 in.
Breadth	18 ft. 0 in.
Depth	10 ft. 1 1-2 in.
Draft	6 ft. 6 in.
Tonnage	121 tons.

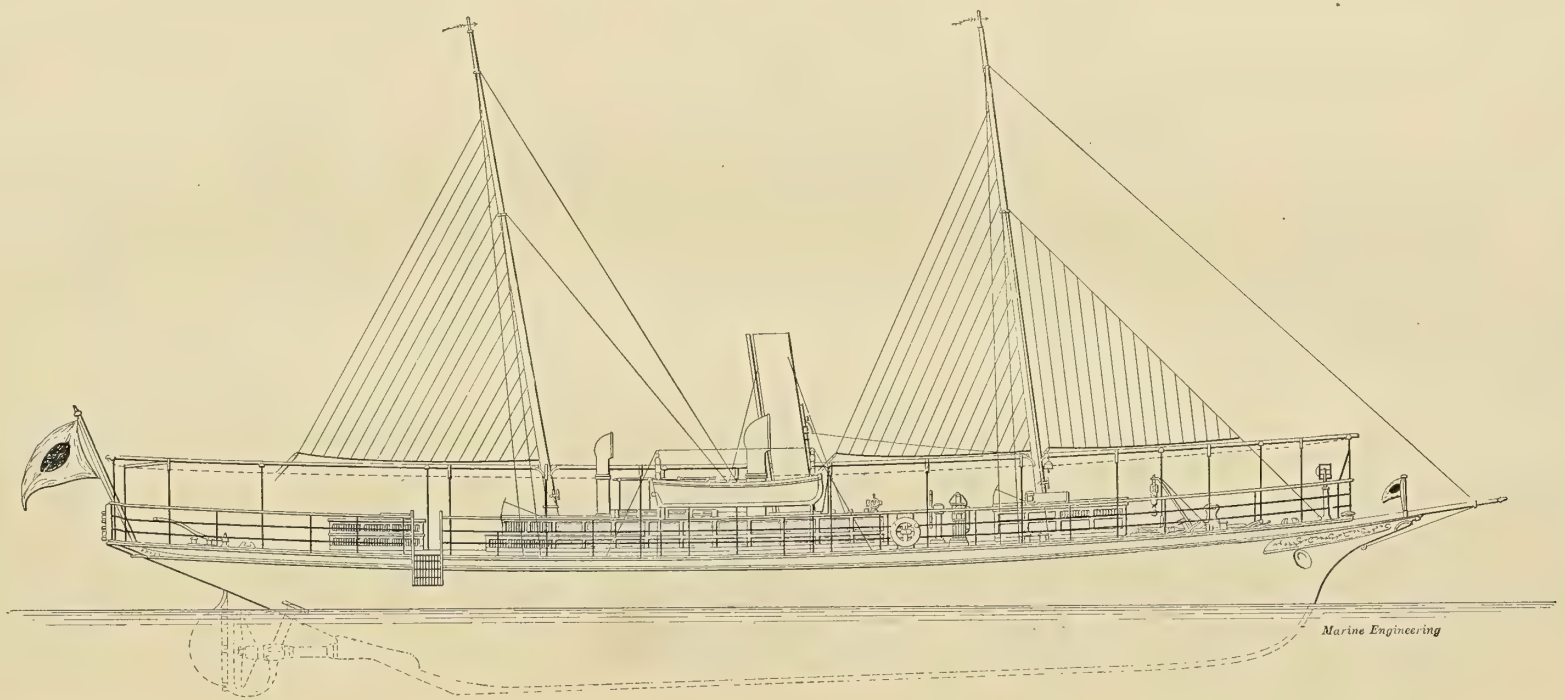
The hull and deck planking is of selected teak wood throughout and all fastenings are of copper and yellow metal.

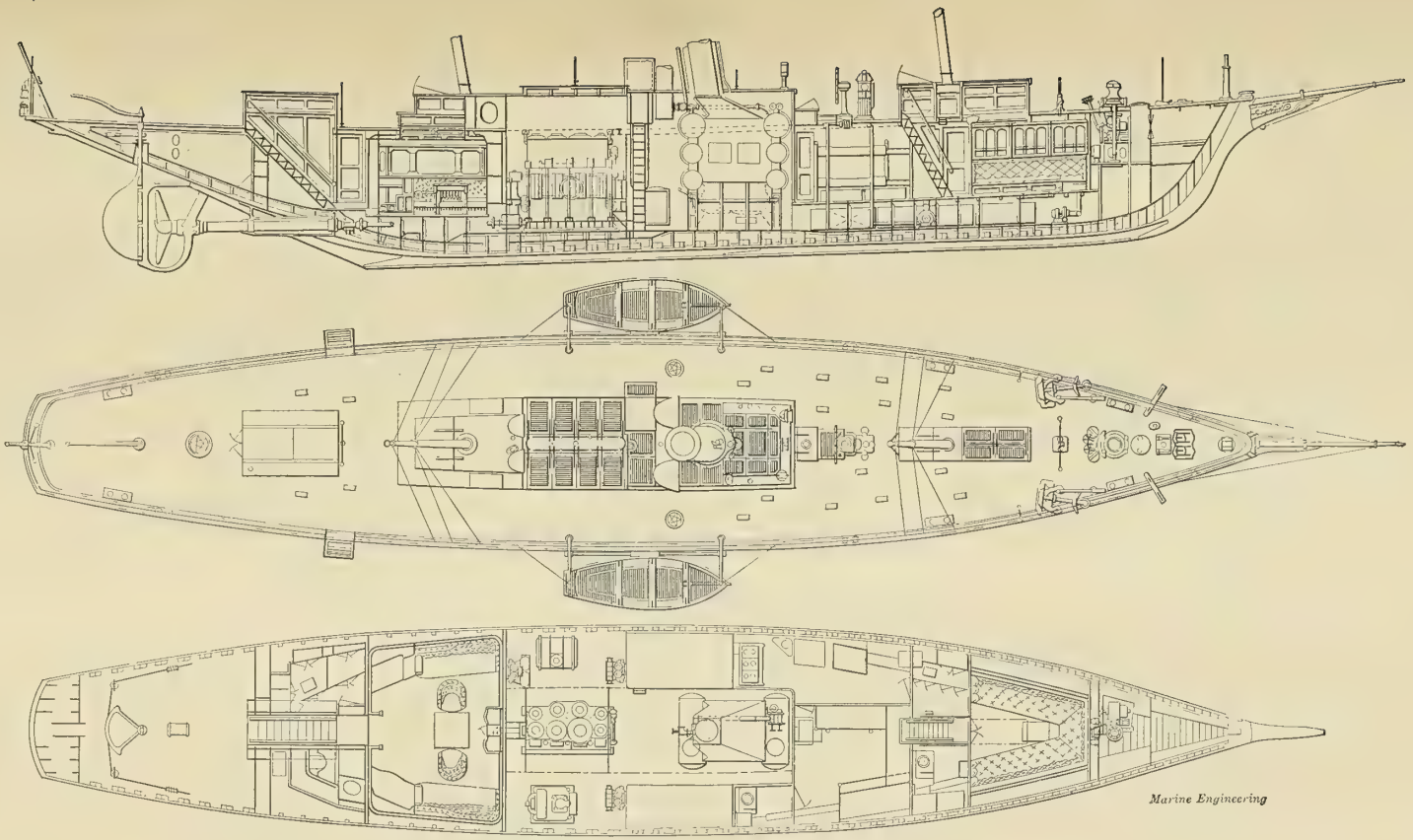
The vessel has four water-tight bulkheads. She is of graceful form, having a long, overhanging bow, with carved head and hanging rails, square stern, one funnel, and two masts. She is flush decked, and engine and boiler casings, companions, etc., are kept flush with the level of the rail. The dead wood aft is entirely cut away, the stern tube being fitted into a gun-metal casting, which is connected to the steel center-girder, the stern-post, which is of gun-metal, is of unique design; the rudder is also of gun-metal, being a solid casting. All deck fittings, such as capstan, steering gear, bollards, fairleads, rail stanchions, etc., are of gun-metal.

Situated immediately abaft of the engine room is the prince's saloon, adjoining which are toilet rooms and pantry. Forward of the boiler space is accommodation for the prince's suite and the crew, also a galley, pantry and toilet rooms.

Baron Iwasaki's particular desire when placing the order for the craft was that care should be taken to make her as comfortable and luxurious as possible, regardless of expense, and if possible, beyond criticism; and when it is considered that this is the first yacht of any pretensions to be built in this country and the difficulties to be encountered in furnishing such a craft, it may well be conceded that the builders have faithfully carried out the baron's desire.

The fittings and decorations of the saloon are of the finest character throughout. The sides of the saloon are finished in a framing of native tochi wood, beautiful in itself, with its frosty-grain on satin-like surface, and panel mounting of cloisonne ware.





ELEVATIONS AND DECK PLANS OF THE IMPERIAL JAPANESE COMPOSITE STEAM YACHT HATSUKAZE.

There are fourteen cloisonne panels worked in the saloon, two of which are 36 inches wide and the others about 18 inches in width. The designs of these panels are as follows: Cherry blossoms, iris and swallows, wistaria and dove, futami (famous native semi-marine scenery), in large panel; peony, stork and willow, wood-lily, poppy, holly-hocks and wild duck, chrysanthemums, Fuji mountain, in large panel; quail, bamboo and cocks, and camellia in snow. These to be arranged from right hand side of entrance, in order, round the saloon, and are specially designed by Mr. Tsunoya, many of whose works are familiar in the Imperial Palace, and who was specially requested to bring the chrysanthemums and wistaria into the design. Whilst the former needs no explanation, the latter represents the crest of her Highness, the Princess, before marriage.

The ceiling is in enamel white and gold. The skylight over the saloon is exceptionally large and so arranged that the whole top-flat can be lifted up, thus making it specially suitable for a warm climate. This, together with saloon companion, is to be glazed with crystal-cut-glass, expressly cut and prepared to the builder's design.

The saloon is furnished with chiffonier, what-not, small writing desk, and table of the same wood as the side frame-work, all of elaborate and dainty design, yet not overdone. The upholstery is of uncut morone silk velvet with flora-paullonia design with table-covers and door curtains to match. The velvet is specially woven and prepared by Mr. Iida to the builder's design. The

floor is richly carpeted with axminster carpet, also with one set of tenzen (wild silk-worm) carpet woven to size in one piece.

The most striking part of the saloon above all is the metal-fittings such as drawer, door handles and pulls, bell-push-covers, candle-lamps, etc.; they are designed and worked by Mr. Susuki, of Tokyo, a member of the Imperial household artisans, and the designs are combinations of snow, moon and flowers, three idols of Japanaese poetical subjects. They are made of gold, silver and other valuable metals.

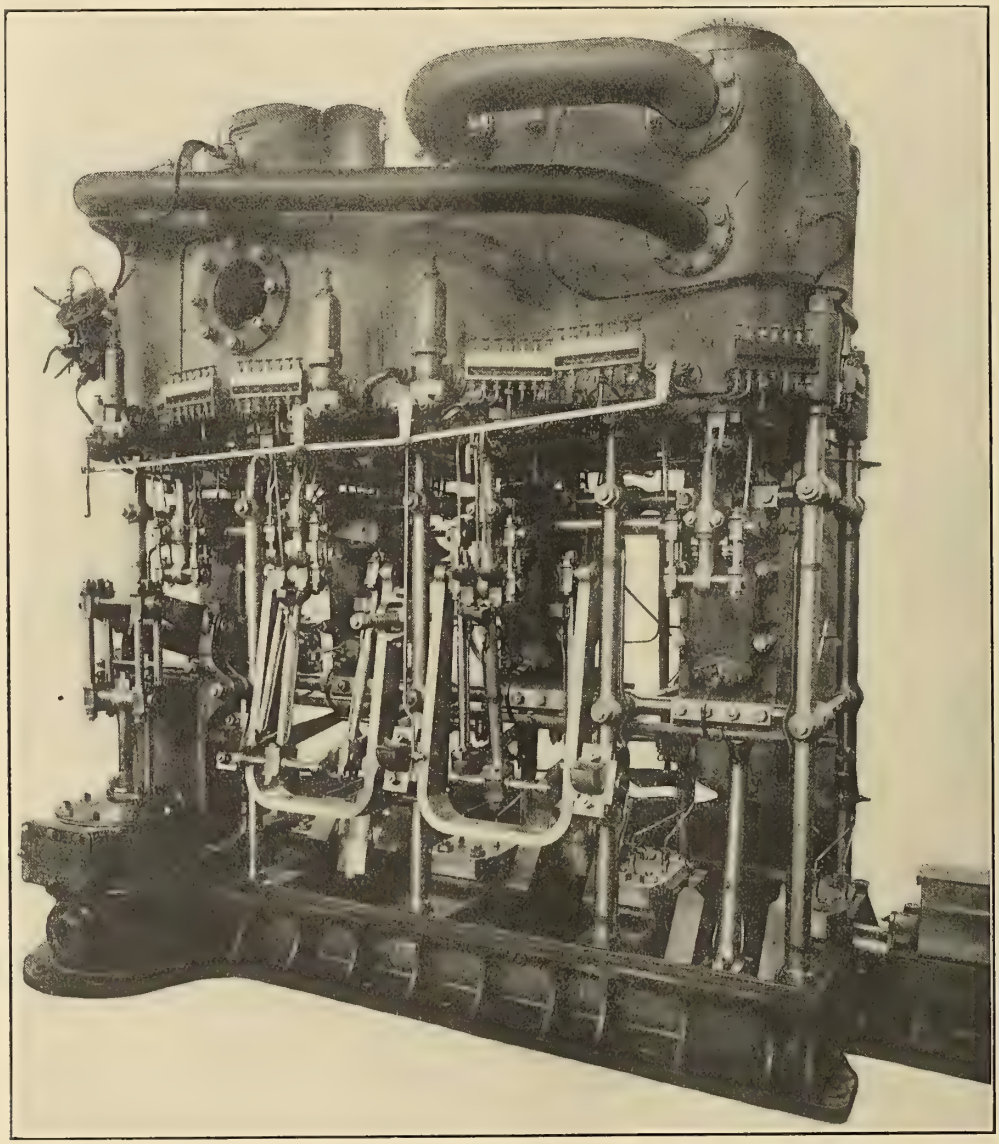
The toilet room is paneled enamel white, picked with gold. The mirror is fitted in a carved frame, and the lavoratory has a marble top and tip-up basin. The marble is from Yamaguchi-Ken, the southern province of the main-island. The toilet room is to be also fitted with under-waterline closet.

The pantry is paneled similar to toilet room, but one could hardly fail to notice the difference of its design from ordinary ship pantries, for most of the exposed parts are made portable and all the lockers are fitted with inner cases, so that they may be easily removed and cleaned.

The sides of the suite's room are paneled with tochi wood in teak framework. The sofa is covered with dark green morocco leather and the curtains are of Kyoto silk damask of similar color.

The floor is carpeted with brussels carpet, also of dark green. The toilet room is fitted with patent fold-up lavatory in oak-case and under-waterline closet. In general respect, the finish and style will be similar to cabins of first class passenger steamers.

All metal fittings in suite's room, pantry and lavatory are electro silver-plated and the floors of pantries, toilet rooms, and passages are covered with India-rubber mats of special design.

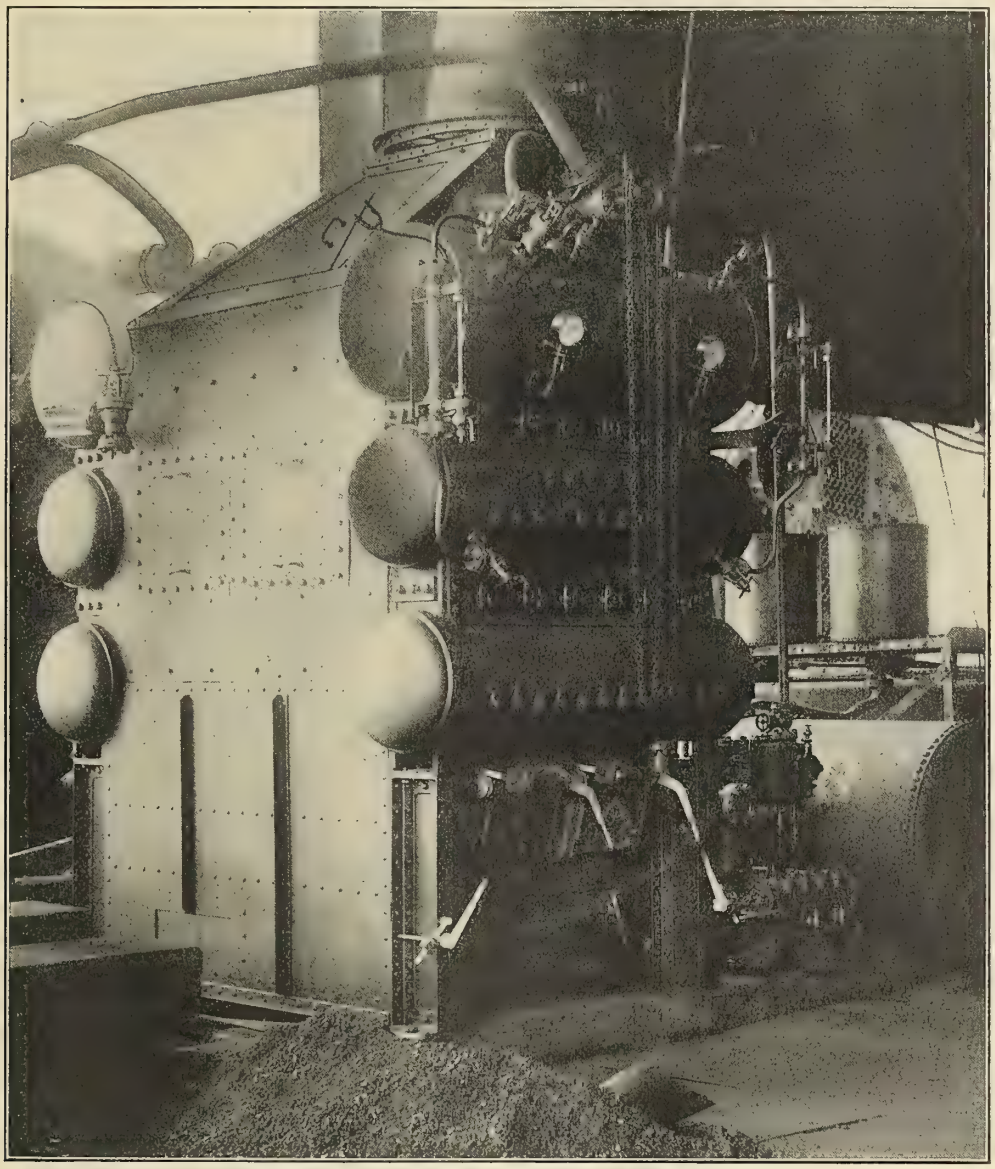


REAR VIEW OF QUADRUPLE EXPANSION ENGINE FOR THE STEAM YACHT HATSUKAZE—JOY VALVE GEAR.

The ventilation arrangement is of most approved description, every attention being taken to suit the climate. This is carried out by four Sturtevant monogram-exhausters. Two are placed aft, for supplying and exhausting the aft-compartment and the remaining two forward for fore-compartment. The supply pipes are so arranged that they may pass through the heated chambers, so as to supply warm air to the compartment in cold weather.

The yacht is fitted with Lord Kelvin's standard compass, with nickel-plated binnacle, electric capstan windlass, and steering gear, both of the builder's design and make, and Chudburn's reply engine room telegraph on nickel plated stand with dials in Japanese characters. In addition, not to depend solely upon speaking tubes in case of temporary derangement of the telegraph, and further to facilitate the working of the yacht, she is to be fitted with Graham's patent ship-telephone to engine room.

There are two small boats, built of mahogany and polished, carried one on each side, and in the vicinity of the boats the yacht is fitted with two Archibald patent life-buoy detaching gears with polished copper life-buoys.



WATER-TUBE BOILER FITTED IN THE STEAM YACHT HATSUKAZE.

A complete electric lighting and power plant is installed. The generating plant consists of one set of General Electric single engine dynamo. A small search-light is also fitted.

MACHINERY.

The main propelling machinery consists of a set of four-crank quadruple expansion engines of the usual inverted marine type, each cylinder driving a separate crank and balanced on the Mitsu-Bishi balancing system,

which is claimed to have proven a distinct success in many steamers built and engined by the firm.

The diameter of the high-pressure cylinder is 7 3-4 inches, of the first intermediate cylinder 10 3-4 inches, of the second intermediate cylinder 15 inches, and of the low-pressure cylinder 21 inches. The stroke is of 18 inches. The arrangement of cylinders forward and aft is: high pressure, low pressure, 2d intermediate, 1st intermediate. The high pressure and first intermediate cylinders and also all piston valve casing are fitted with liners.

Each valve is of piston type and placed diametrically at the back of each cylinder, and high pressure and the first intermediate pressure piston valves will take steam at inside and others at outside. The valve gear employed is of Joy's radial gear type. The air pump is driven by levers off the cross-head of the high pressure engine and is of Edward's patent.

The cylinders, liners, covers and sole-plate are all of cast iron and the columns of polished forged steel. The main bearings, "ahead" thrust shoes, and blocks are all lined with white metal. All the shafting is of forged steel. The propeller is four-bladed, made of navy-bronze. The condenser is separate from the main engines, placed longitudinally fore and aft, and of cast brass, the door and end which take the inlet and branches are also of brass castings. The total cooling surface is 265 square feet. Two efficient duplex pumps are fitted to complete the pumping system of the yacht.

Steam at a pressure of 220 pounds per square inch is supplied by Dr. Miyabara's patent water tube boiler. The general design of boiler consists of two water walls forming the front and back of a combustion chamber, each composed of three horizontal steel drums, arranged one above another, and connected together by short vertical tubes, the upper drums being steam chambers. A series of diagonal steam generating tubes connects the drums of the two walls and cross each other over the fire-grate. Within the two middle drums and enclosing the ends of the two groups of generating tubes which meet therein, diaphragm boxes are fitted for the purpose of separating the up-cast water rising through the generating tubes, from the down-cast water, running down from the top steam drums to the bottom water drum. These diaphragm boxes are of sufficiently short lengths and fitted in a simple manner so that they can easily be removed and replaced if required without interfering with any other part of the boiler. The back steam drum is connected to the front one by means of a steam pipe running through the up-take. The feed water is introduced in the back steam drum into an open box. There is a communicating pipe connecting the two bottom water drums in order to keep the same level of the water within the two water walls, and a suitable mud or sediment collector is fitted on this pipe at the lowest part of the boiler.

The area of the fire grate surface is 21.875 square feet, the length of fire bars being 5.5 feet and the total tube heating surface is 780 square feet.

On her trial she attained a speed of 12.43 knots. Externally she presents a very pleasing appearance, with her graceful sheer and fine finish, and is unquestionably the prettiest craft that has ever graced Eastern waters.

YAMACHO.

12,726-MILE RUN OF THE NEBRASKAN BURNING OIL.

A most remarkable run with oil as fuel was completed on March 26, when the American-Hawaiian steamship *Nebraskan* arrived in New York from San Diego, Cal., steaming all the way with oil as fuel. The distance covered was 12,726 nautical miles, and the steaming time 51 days 7 hours 26 minutes, an average speed of 10.35 knots. Only twice during this run was the throttle closed, and both of these times happened in the Strait of Magellan, once for anchoring because of the tide, and the second time at Puntas Arenas to telegraph her owners. Both of these stops amounted to 21 hours 37 minutes, which to obtain the total time for passage is to be added to the steaming time. On the trip 8,826 barrels of Bakersfield (Cal.) residium oil were burned, which weighs 336 pounds per barrel, making 1324.7 long tons for the voyage. The trip was most successful in point of speed, absence of delays and regularity of steaming.

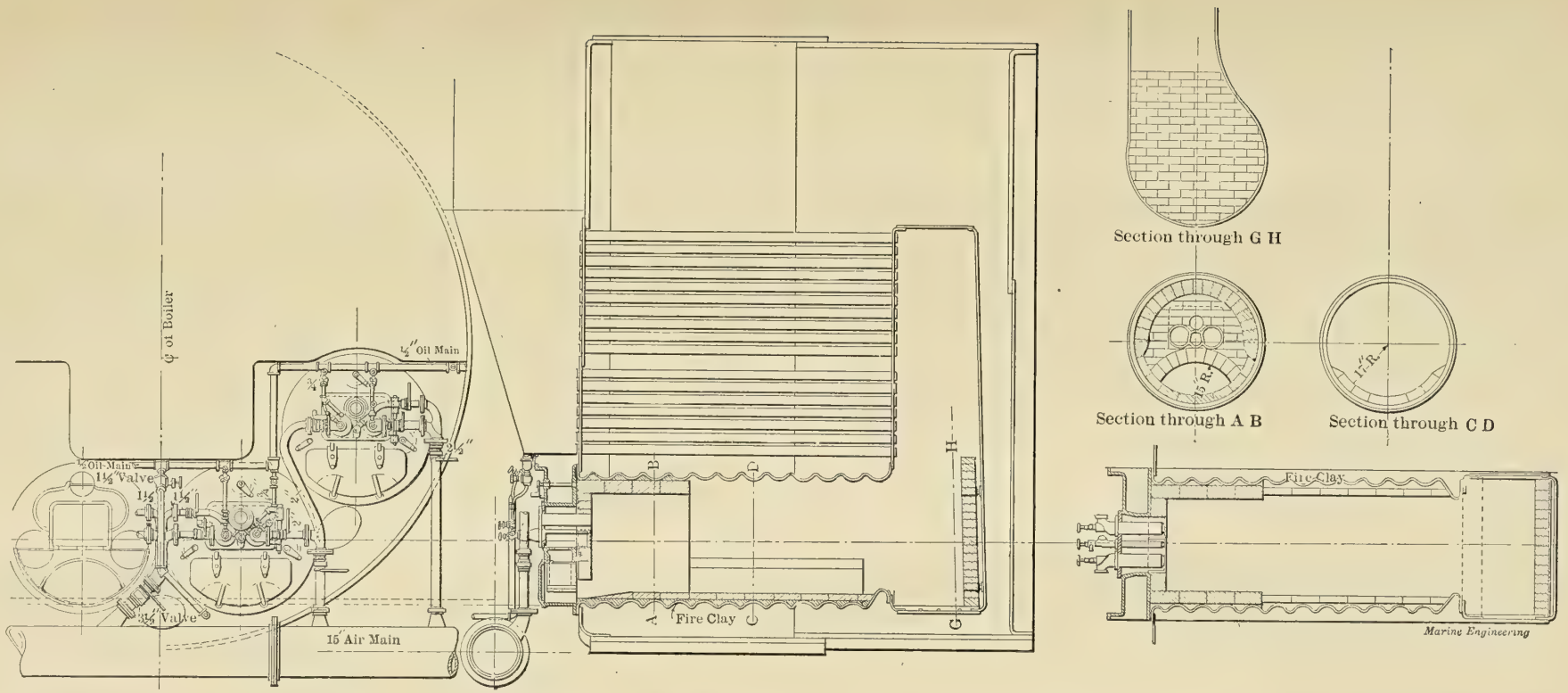
The *Nebraskan* was fitted for burning oil fuel by her builders, the New York Shipbuilding Company, but the equipment was not installed until after she had arrived at San Francisco, so she made the first trip out burning coal under the boilers. Since that day, until the ship sailed for New York, she has been engaged in the transpacific trade to Honolulu, and so successful and economical was the oil fuel apparatus that it was determined to send her round to the Atlantic as an experiment to demonstrate the adaptability of this fuel for a long run.

The company has collected a great amount of valuable data from which it was possible to calculate almost exactly the amount of oil to be required a day, and the speed in knots. In fact the ship arrived in New York on the day determined upon by previous calculations. This, of course, would be impossible with a coal burning vessel because of first the uncertainty of the time required for coaling at St. Lucia and Coronel, which requires anywhere between one and a half and five days; and, second, while with oil the exact steam pressure and revolutions may be maintained throughout the trip with very slight variation, in a coal burning steamer there is always more or less unavoidable fluctuation of steam pressure, especially at such times as cleaning the fires.

The ship arrived in port with as clean boiler rooms as when she left San Francisco. The oil burners are so efficient that complete combustion is obtained and there is absolutely no smoke, soot, or other deposit left on the furnaces or tubes or emitted from the funnel. In fact white paint is used in painting the upper boiler room.

DESCRIPTION OF MACHINERY.

The *Nebraskan* is fitted with two sets of three cylinder triple expansion engines 19, 31 and 54 inches diameter of cylinders, by 42 inches stroke. Steam is supplied at a pressure of 200 pounds by two single-end Scotch boilers. The boilers are placed with axes fore and aft with the rear ends through the engine room bulkhead. Four furnaces are fitted in each boiler, each furnace has separate combustion chamber and is equipped with two oil burners. Spiral retarders with



PATENT OIL BURNING SYSTEM AS INSTALLED ON THE STEAMSHIP NEBRASKAN WITH TWO LARGE AND ONE SMALL BURNER TO EACH FURNACE; OF LATE THE SMALL BURNER HAS BEEN REMOVED

eight turns per length are fitted in tubes. The feed water is driven by the pump through a surface heater where it is heated to over 212 degrees. This heater is composed of a nest of copper tubes around which flows the steam from the auxiliary exhaust, and is so connected that in port it may be used as an auxiliary condenser. The air and bilge pumps are direct connected by levers to the low-pressure crosshead. Each circulating pump is of the centrifugal type. A straight-tube Williamson evaporator, capable of evaporating 25 tons of fresh water in twenty-four hours, is fitted in the upper engine room. The electric lighting plant consists of two sets of direct-connected General Electric generators each of ten k. w. A steam steering gear is placed in the upper engine room and is of the Williamson type. Further particulars will be found in the data card on page 208.

OIL BURNING SYSTEM.

The oil burning equipment is of the Lässœ-Lovekin patent system, the principle features of which are, that oil under a pressure of about 15 pounds is atomized by compressed air at 1 1-2 pounds pressure and all the air to support combustion is heated before entering the furnaces. The apparatus is very simple and can be taken care of by an oiler. The air for combustion is heated by the Howden system.

The burner consists of a cast iron pipe about 4 inches diameter and 18 inches long. Into the rear end are lead the oil and air pipes, while into the front end is screwed a perforated plate forming the nozzle. Through the center of the burner is the oil supply pipe, and the rest of the space is filled with compressed air. A needle oil valve is placed at the inner face of the nozzle plate with stem extending back through oil pipe to the regulating hand wheel. In the center of the nozzle plate is

a 1-8 inch oil hole, and around it on a diameter of about 2 inches are drilled a series of larger holes with axes parallel, and inclined radially and tangentially to the axis of the burner. The air passing through these holes catches and atomizes the oil, and spreads the flame into a cone-shaped sheet giving a large surface for combustion. The blower draws its air through the heating tubes in the smoke box of the boiler, and delivers it to a large chamber run below the boiler room floor across the fronts of the boilers. Compression is so slight that the temperature is not increased but a few degrees above that of the regular entering air, viz., 250 degrees. There is a controlling valve for the air at the burner, and there is also a stop for the oil which comes down from above across the front of the boiler. Regulation of the oil is secured through the needle valve as above stated. To avoid the possibility of a burner clogging, it is the chief engineer's order to have one burner from each boiler cleaned on each watch. This clogging up, however, practically never occurs, as the oil is strained beforehand, and no deposit forms on the burner.

Oil is stowed in the peak tanks, the water ballast tanks forward of the boiler room and aft of the engine room, and in a deep tank placed forward of the boiler room. A cofferdam is fitted at the forward and aft ends of this deep tank. The supply of oil from the boilers is drawn from the deep tank, which acts as a settling chamber for removing the entrained water in the oil. This tank may be filled from any one of the water ballast compartments by means of a steam pump placed in the engine room and a manifold and pipes similar to water ballast system. The oil supply from the tank is taken by a steam pump and discharged into a vertical cylindrical heater under pressure of about 15 pounds. In this heater is a coil into which exhausts the auxiliaries of engine and boiler room sufficient to raise the temperature of the oil to about 180 degrees. At this temperature the oil becomes very much thinner, *i. e.,* of less viscosity, so that it may readily pass through the pipe and to the burners. The discharge from the heater is passed through a strainer box fitted with duplicate strainers. Should the oil in the deep tank become too chilled for readily passing to the pump, steam may be turned on into coils placed in the tank near the suction, but this has never as yet been necessary. A No. 4 Wilbraham blower is placed opposite each boiler and is driven by a single cylinder vertical steam engine. As above stated, the suction of the blower is through the air duct at the base of the air heater in the smoke box. The entire plant of oil pump, heater, blower, etc., is in duplicate, each capable of working the two boilers at one time.

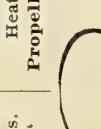
It is estimated that the fuel oil auxiliaries indicate about 30 horse power, taking on an average of 60 pounds of steam per I. H. P.

MARINE ENGINEERING DATA CARD. **MAY, 1904.**

NAME—Nebraskan. NATIONALITY—American. TYPE—Ocean freighter.

LAUNCHED—1902. BUILDER—New York Shipbuilding Co. OWNERS—American-Hawaiian Steamship Co.

Length over all	371 ft. 6 ins.
" between perps	360 " 0 "
Beam, molded	46 " 0 "
Depth, "	27 " 2 "
Draft, mean load	24 " 0 "
Displacement, corresponding	8,650 tons
Oil bunker capacity	1 200 bbls.
Water tanks under engine room	150 tons
Number of steel decks	3
Engines: Number	2
Type	3-cylinder triple
Cylinder diameters	19, 31 and 54 ins.
Stroke	42 "
Condensers, cast-iron shell separate from framing surface (2)	5 230 sq. ft.
Boilers	2
Diameter	16 ft. 3 ins.
Length	11 " 6 ins.
Working pressure	200 lbs.
Furnaces, number each	4
Inside diameter	41 ins.
Tubes, number each boiler	390
Diameter outside	3 ins.
Length between sheets	8 ft. 3 "
Combustion chambers, separate for each furnace.	
Depth, top, 27 ins.; bottom	30 ins.
Grate surface, two boilers	156 sq. ft.
Heating " "	6 000 " "
Propellers: Material, cast steel hub bronze blades.	
Diameter	13 ft. 0 ins.
Pitch	17 " 0 "
Area developed	55 sq. ft.



TRIAL DATA. **MARINE ENGINEERING DATA CARD.** **MAY, 1904.**

NAME—Nebraskan. NATIONALITY—American. TYPE—Ocean freighter.

LAUNCHED—1902. BUILDERS—New York S. B. Co. OWNERS—American-Hawaiian Steamship Co.

Averages for entire voyage between New York and San Diego, Cal.

FUEL	COAL.
Left	S. D., Feb. 3, 1904.
Arrived	N. Y., Mar. 26, 1904.
	days. hours. min.
Time of voyage	52 5 03
Steaming time	51 7 26
Detention in Strait of Magellan	53 20 20
Distance covered, nautical miles	12,726
Draft, mean, leaving	25 ft. 1-2 ins.
" " arriving	21 " 8 1-2 "
Displacement, mean for trip	8,417 tons
Steam pressure	180 lbs.
Throttle	Full open
R. P. M	73.83
I. H. P., main engines	1,986
I. H. P., total	2,196
Average speed, knots	10.35
Slip of propellers, per cent	16.56
Time out of dry dock from arrival in port	6 mos. 3 days
Admiralty coef	230.
Oil, Bakersfield residium	150° B at 60° F.
Barrels of oil for trip, total	8,826 bbl.
" " per hour	7.17 "
Lbs of oil per I. H. P. per hour	1.10 lbs
Miles per barrel of oil	1.44
Air pressure at fan	0.8 in.
" " " blowers	1.5 lbs.
Temperature oil in heater	150° F.
" base of stack	495° F.
Kind of coal	Eureka and Coronel
Coal for trip, total	2,269 tons
" per hour, average	3,933 lbs.
Miles per ton of coal	5.85

OPERATION.

This system has been found to give great satisfaction in many ways. In the first place, the fire room force has been cut down. With coal, three firemen and two coal passers to a watch were carried; with oil, there are two, one termed "oil tender" and paid the same rate as the water tender, and the other a "wiper," rated as coal passer, to a watch. The water in main boilers is looked after by the engineer, as the rear ends of the boilers which project through the engine room bulkhead are fitted with gauge glasses, etc.

Regulation is attained to a very fine point. A peep-hole is fitted in each furnace door. When running full power the two burners on each furnace practically fill the entire furnace with incandescent flame. The bottom of the furnace is lined with brick, and the throat has a brick arch sprung around it to protect rivets, etc. A brick wall is built up at the back of each combustion chamber to a point a little above the top of furnace. This construction is shown in the drawing on page 207.

While there is great saving in weight of fuel, and in fire room force, there is also in the favor of this oil burner the fact that there are practically no repairs required on the boilers. The even, constant heat, and absence of cold draft, due to keeping furnace doors closed, have cut down repairs required on the boiler to practically nothing. As there is no deposit from the oil, the tubes and combustion chambers do not have to be cleaned and heating surfaces remain at highest efficiency.

By reason of past experiences and records, it is now possible to so regulate the burners that any steam pressure up to that allowed may be maintained for days at a time with but very slight variation. It is stated that on this trip of the *Nebraskan* the maximum difference was 2 pounds for the entire run.

LOADING.

In place of its taking several days to fill the coal bunkers, it requires but three hours to receive 1,200 barrels of oil. The oil from the supply on shore is pumped into the deep tank, then by means of the oil manifold box and piping, it flows by gravity into any one of the water ballast tanks. When the oil is being burned, each day the deep tank is filled from one of the other tanks to a certain level sufficient to last for twenty-four hours. Because of the great care observed in making these oil tanks watertight at the time the ship was built, no leakage, whatever, has occurred.

PERFORMANCE.

Bakersfield oil has an asphaltum base and the grade burned on the *Nebraskan* has been distilled once to drive off the lightest oils and contains about 17,000 B. T. U. per pound. In figuring the oil per I. H. P. the power is estimated by indicator cards and the average revolutions throughout the trip, and is not a fancy figure for temporary conditions.

Taking into consideration first, saving of labor; second, saving of weight of fuel carried; third, decreased repairs to boiler; fourth, facility and perfection of regulation; fifth, absence of soot, ashes; sixth, increased speed; seventh, less delay in time required in loading, we can surely estimate a great saving for the oil fuel. The chief objection to its use appears to be the fluctuation in the price of oil fuel on the Atlantic, and the somewhat uncertainty as to its supply. On the other hand must be mentioned, first, the increased cost of installing the oil equipment, and second, the necessary greater repairs to such equipment. It is stated by the company, however, that the last item is exceedingly small.

For the purpose of comparison there is given page 208 the engineer's report for the first passage of the *Nebraskan* from New York to San Diego, commencing August 7, 1902, on which coal was burned. In comparing this with the last passage of the ship with oil fuel special attention must be given to the difference in the average slip for each passage. Coming out, the ship's bottom was cleaned and the slip amounted to 11.9, while on the return passage the ship had been out of dry-dock for six months and the average slip was 16.56 per cent. Even with this increased slip against the oil burning passage there were 945 tons less of oil fuel burned than coal for the outward passage. On the other hand, the distance run on the outward voyage was 554 miles more than on the return run, because of necessary stops for coaling at St. Lucia and Coronel. We may easily calculate the time that would be saved on the return voyage if the slip had been the same as on the outward voyage, and this equals 36 hours and 41 minutes. Ships on this run make about two round trips to New York a year. On the Pacific they call at the California and Washington ports and also at Honolulu. On April 17 the *Nebraskan* sailed for San Diego with a supply of Texas oil. She was put in dry dock, cleaned and painted prior to leaving so that the run out will be made under conditions nearer like her first voyage with coal. Then a fairer comparison may be made of the two fuels.

Through the courtesy of the general manager, Captain W. D. Burnham, the superintending engineer, V. F. Lässoe, and his assistant, C. M. Magruder, the above facts were ascertained. John Mitchell is chief engineer of the *Nebraskan*.

The Dispersion of Fogs.—Not long since attention was called to the suggestion of Sir Oliver Lodge, that fogs might be dispersed by means of electric discharges into the atmosphere at high voltages. Tests which he had made were successful, though the area affected was quite limited, and it is doubtful whether his process could be carried out on a sufficiently large scale to make it of great value. This idea is brought to mind again by the work of two Germans, Richarz and Schenck, who have found a striking analogy between radioactivity and the behavior of ozone. Freshly prepared ozone has the power of causing condensation in a steam jet. Now, ozone is a gas which can be made easily in large quantities, and it might be possible to make use of its power to disperse fogs. The ozone could be set free at various points, and would rapidly disperse itself through the fog. Just what effect would be secured can not be said. It may be that the condensing effect is too slight to be of any practical value. However, further investigation of this property should be made, with a view to determining how long its power persists, and what quantity of ozone is required to keep a certain volume of air clear. The experiments could be conducted easily at some of the ozone water sterilizing plants which are now in operation.—*Electrical Review.*

GAS AND OIL ENGINES ON SHIPBOARD.*

BY JOHN E. THORNYCROFT.

It has been recognized for some time by engineers who have to do with large power installations for land purposes that the reciprocating steam engine has been developed to a stage that cannot easily be improved upon; and that if greater economies are required, they must look either to the steam turbine or the internal-combustion engine. Naval architects and marine engineers have been quick to take up the steam turbine; but although the internal-combustion engine has been developed to a high degree of efficiency on land, it has, up to the present time, only been used to a limited extent for marine purposes, and then only for driving launches and small craft.

The advantages which oil and gas engines offer are so great that it is difficult to understand why they have not been more largely used. They necessitate the employment of some complications which steam engines avoid; but the one great advantage of their requiring neither boilers nor condensers will, it is thought, be found to more than compensate for these complications. Before making a direct comparison it will be well to consider the different systems, and the way in which they work.

CLASSES OF ENGINES.

Internal-combustion engines may be divided into several classes, according to the fuel they employ:

I. In which the combustible employed will vaporize at atmospheric temperature.

II. In which the combustible requires vaporizing by heat or by spraying.

III. Gas engines, using gas from some form of producer using solid fuel.

Engines of the First Type.—The Daimler motor is representative of the first type, and practically all the engines working on the Otto cycle with this class of fuel are developments of Daimler's orginal engines, and are the simplest and lightest of the different types, as the fuel, in the form of petroleum spirit, is drawn into the cylinder with the amount of air necessary to burn it by the suction stroke of the engine. The apparatus for mixing the spirit with the air is of a very simple character, and the class of fuel permits of a high degree of compression being employed without danger of premature ignition; this high compression produces a high explosive pressure, and the cylinders of the engine are small in proportion to the power, and so the engine is light. Engines have been made by the German Daimler Company up to 300 brake horse power, by several American builders up to 150 brake horse power, and by Messrs. Vickers, Sons, & Maxim up to 300 brake horse power for British submarines.

Most of the leading motor-car builders, both on the Continent and at home, have built engines of considerable power of this type, which have been fitted to launches. In America there are a number of firms building small types of engines which do not follow the Otto cycle, but give an impulse at every revolution by using the under side of the piston and crank chamber for pumping the charge of explosive mixture into the cylinder. This type cannot be run at a high speed, and is not suitable for large powers.

Engines of the Second Type.—There is a much greater variety of engines coming under the second heading, as the difficult problem of vaporizing the fuel has been treated in a variety of ways by different builders.

The stationary oil engine has been made very perfect for work where there are no very rapid or great changes of load; but for marine purposes, where a considerable amount of variation takes place in manœuvering, the problem becomes much more difficult. Most of the engines work on the well-known Otto cycle, and the variations occur in the different methods of introducing the fuel and vaporizing it. In the case of the Priestman and Griffin—two of the earliest—the fuel is sprayed by air pressure into a vaporizer heated by the exhaust products, and then taken into the cylinder on the suction stroke. In the Vosper and Roots engines it is either pumped or measured into a vaporizer without being sprayed.

In the Hornsby engine the oil is pumped directly into an extension of the cylinder, which is maintained at a high temperature, and the air is introduced separately. This method has the advantage of great simplicity, as no igniting device is required, as the heat of this chamber is sufficient to ignite the charge on compression; but it is only possible to work with a very low compression, to avoid premature ignition, and therefore the type of engine is necessarily a heavy one.

The Diesel engine, which has, as yet, been only used in one or two cases for marine purposes, is a most interesting type. It works on the four-stroke cycle, but sprays the oil into the cylinder by means of compressed air at the end of the compression stroke, the compression being so high (viz., about 500 lb.) that when the oil is sprayed it at once ignites owing to the heat of the compression, which is about 1000 deg. Fahr. There is no actual explosion, as the fuel is introduced into an excess of air, and burns as it is injected. A gradual and complete combustion of the fuel takes place, resulting in a very high economy. The power can be regulated to a great nicety, as the fuel is always burned at the same temperature, but in varying quantities. The engine is, however, necessarily a heavy one, to withstand the very high pressure, and the lightest type so far gives only about 10 horse power per ton.

The Strickland engine is designed on the same principle, of injecting the fuel at the end of the compression stroke, but does not compress to more than 200 lb., and therefore has to use an igniting device. It is also arranged to work as a two-cycle engine, giving an impulse at every revolution, as some of the Diesel engines have done. It is fitted with a prolongation of the piston to form a pump to supply the air for the scavenging stroke, and the necessary air for combustion.

It would seem that an engine of this type, not working at too high a compression, so that it does not require to be so very strongly built, and giving two impulses for one of engines working on the Otto cycle, should have very great advantages, as a high mean pressure can be obtained without danger of premature ignition, and no vaporizers are required for the fuel, the vaporizers being always the part of the engine

* Paper read before the Institution of Naval Architects, London, March 24, 1904.

most difficult to design, and requiring the largest amount of attention.

Engines of the second type will always be more difficult to handle, in consequence of the vaporizing difficulties, than the first and third; but it is probable that because of the portability, safety, and comparative cheapness of the fuel, they will be used very extensively.

Engines of the Third Type.—The gas engine has hardly yet been tried for marine purposes; but, owing to the recent great improvements in gas producers, it is thought that they will soon be used extensively.

An engine designed for working with gas from solid fuel consists essentially of the same parts as engines of the first and second classes without the apparatus for vaporizing the oil or spirit, the gas producer taking the place of the vaporizer, but being necessarily much more cumbersome. But the gaseous fuel which is produced is essentially different to that produced by the vaporizer or carburettor of engines of the first two classes, as it is a stable gas, and can be stored if desired, and the vapor cannot; so that when manœuvering is taking place, and the engine is being stopped and started, the producer is not entirely put out of action, as is the vaporizer, but to some extent can act as a flywheel and reserve of power, like a steam boiler.

The recent improvements, which have enabled the producer to be worked without the reservoir for the gas, the engine sucking the supply directly from the producer, makes the apparatus much less bulky, and therefore better adapted for marine purposes.

The first type of engine is necessarily the lightest, as there is no vaporizer or producer, the fuel being vaporized by the simple expedient of sucking the right amount of fuel in with the air to the cylinder. Engines of this class are being made to weigh not more than 10 lb. or 12 lb. per brake horse power. Comparing this figure with that of the modern torpedo boats or destroyers, which is 50 lb. per indicated horse power, it is evident that the naval architect has great possibilities with this type of engine. There is every prospect that engines of the second class will be built, including the vaporizer, for not more than 25 lb. per brake horse power, for moderate sizes. The engine of the third class should not be heavier; but, of course, there must be added the weight of the producer.

Starting and Reversing.—The smaller types of engines for launches are very easily handled, it being possible to start them up by a few turns of the engine; but when the size gets too great to be man-handled, other means of starting have to be devised. In the large engines used in submarines, the engine is used in conjunction with electro-motors and dynamos, so that the motor can be used for starting up the engine.

In the case of the first and third classes, the starting is not very difficult, as the engine can be turned slowly with a suitable turning gear, and then, the cylinder being full of an explosive charge, they can be fired electrically at the right time, and the impulse is sufficient to carry the engine round for several revolutions, and set it in operation.

In the case of the second class this is not practicable, and it is necessary to have a reservoir of compressed air or gas of sufficient volume to give the engine several turns working as a pressure engine; this, of course, necessitates additional valves for the purpose. In smaller motors it is possible to reverse either by a reversing screw, or in some instances it is accomplished by stopping the engine, and by having suitable cams for operating the valves and starting the engine in the reverse direction by hand; but this has not been found very satisfactory, and the best practice seems to be to fit the engine with a suitable reversing gear and clutches for throwing it in and out of gear. It is at present unknown to what sizes these reversing gears can be successfully built, but recent improvements in clutches made by Professor Hele-Shaw go to show that there should be no great mechanical difficulties in producing them up to several thousand horse power.

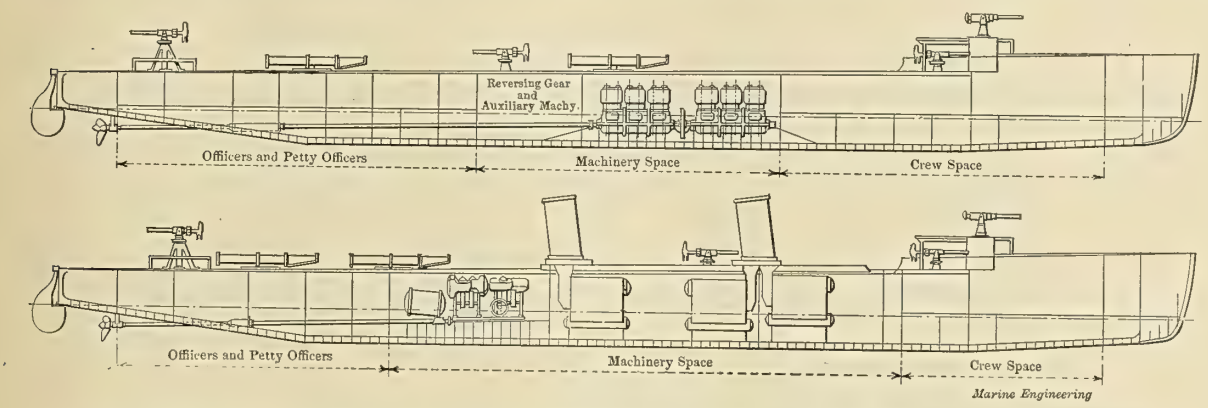


DIAGRAM SHOWING COMPARISON OF SPACE DEVOTED TO MACHINERY IN A GAS ENGINE- AND STEAM-PROPELLED TORPEDO BOAT.

The Bertheu engine has been specially designed with a view to making it very easily handled. Reservoirs are provided into which the engine compresses or delivers the burned products of combustion at a high pressure; compressed gases in this reservoir being used when required for starting up the engine, or giving it a few impulses in a reverse direction when it is required to go astern. The engine is provided with a double set of cams, either of which can be thrown into operation, and at the same time the engine is converted from a four-cycle to a two-cycle, to better enable it to maintain its speed when it is being driven by the compressed gases as a pressure engine. The author's firm are building engines of this type of considerable powers, and he thinks

that probably, although the engine is complicated by these appliances, it will be found better in the larger sizes than any reversing gearing.

A comparison of the weights and space occupied by comparatively low-powered engines of the first class, fitted to launches in the place of steam engines and boilers of the same power, shows very greatly in their favor, but when petrol is used as fuel, it will be found more expensive than coal to do the same work. On the other hand, as the engines are practically automatic in action, and can be started at once (requiring no preparation like a steam boiler), an engine-driver can usually be dispensed with; and, as the steersman can do all the work of controlling the vessel, it will frequently be found cheaper to run with this class of engine than with steam.

While there is very little danger from fire with properly-constructed engines, fitted with electrical ignition, and using spirit or oil of a low-flash point in open boats, the risk must not be disregarded where they are fitted in a closed engine room below decks.

Captain du Boulay has devised an arrangement by which only a small quantity of fuel is kept in the engine room, in a small tank, any leakage draining directly overboard. The main supply is stored in a tank in a specially bulkheaded compartment, which also drains overboard; and in some cases the sea is allowed to flow into it and around the tank, thereby avoiding any possibility of the leakage of oil into the bilge of the vessel.

With engines of the second class, using oils having a flash point of above 75 deg. Fahr., there is practically no danger from fire; and when the engine will work with less than 1 lb. of oil per horse power hour, the cost of working will, as a rule, be found less than that with the equivalent steam machinery; but, as yet, there has always been the disadvantage of an objectionable exhaust.

The Diesel engine costs only one-tenth of a penny per hour, as it works with unrefined oils, which can be bought for *2d.* per gallon, and uses less than half a pound of oil per horse power hour. Only the most economical steam engines, supplied with coal at not more than 10*s.* per ton, can equal this performance.

It is well known that gas engines of even small powers, supplied with producer gas, give considerably more power per pound of fuel than could be obtained with a steam engine and boiler, and when large plants are used, a given quantity of fuel will produce about four times the power obtainable with ordinary steam engines.

Gas producers must be divided into two classes—those which work with non-bituminous coal, and those which work with bituminous. The former class working as a suction producer is very simple, and weighs, as made for land purposes, considerably less than the ordinary type of steam boiler to do the same work but, owing to its being restricted to one class of fuel, its use must be very limited for marine purposes.

The producer invented by Dr. Mond for using bituminous fuel has not yet been worked out suitably for marine purposes, and as used on land is heavier than boilers of the same power, but it seems probable that, owing to the much greater economy obtained and the rapid development which is going on, it will soon be possible to employ producers of this type.

The illustrations on page 211 show the relative space occupied by the machinery of a torpedo boat destroyer fitted wth the usual machinery, and an engine of the second class working on the Otto cycle at the same piston speed as the steam engine.

Other drawings and views were given of the Bertheau oil engine, which has already been described in *Marine Engineering* in December, 1903.

DISCUSSION.*

In the discussion which followed, Captain du Boulay said that he had been experimenting with petrol and paraffin engines since the year 1886, his principal effort being to get over the danger of fire from petrol. He had fitted several boats in which the main quantity of petrol was carried on deck, the arrangement being such that any leakage was passed into the sea. The vaporizer, or carburettor, was a source of danger if it failed to work, as there would be overflow and leakage of oil. He had recently managed to get the whole of the petrol stored on deck, so that there would not be any at all in the engine room, the mixture being drawn down for use by a suction pipe. As air was drawn in—there being a partial vacuum—if there were any defect in this pipe, the vapor would not escape. The arrangement, however, needed very careful fitting to get a regular and proper supply of vapor.

Mr. Linton Hope referred to some boats designed by him, and fitted with Blake motors, one of which—a seagoing yacht—had been running for some time, and had given great satisfaction to the owner, who said he had no trouble with this class of engine. It ran at 400 revolutions, occupying a space of 3 feet by 6 feet. The vessel made a speed of 7 knots with 35 brake horse power. The weight was 10 lbs. to 12 lbs. per horse power. Another oil motor which he had used, and which gave 172 brake horse power, weighed under 10 lb. per horse power.

Mr. A. E. Seaton failed to see that Mr. Thornycroft had made good his title to "Some Advantages of Gas and Oil-Engines for Marine Purposes," for, as far as he could see, there were not any advantages for ordinary marine propulsion. He did not think that the internal combustion engine would drive steam out of the field; there would be many difficulties. What he would ask would be as to the rate of insurance; and, How would a captain like to have on board an engine that would not reverse and was not sure to go ahead or astern when called upon to do so? Latterly he had tried to get some makers of oil engines to tender for one of 500 horse power, but he had failed to do so; they could only offer two motors of 250 horse power each. He would like to know how long the pistons would run before they melted. The first rotary oil engine was used in the year 1818, but that was worked with turpentine.

Mr. S. W. Barnaby said he thought Mr. Seaton was in too great a hurry in criticising the application of the oil engine to big ships. In regard to seawork, however, he would say that his firm had recently had in their hands a small boat which had come across the Atlantic, and which was fitted with an oil motor. Sir William

* This discussion is taken from *Engineering*, London, April 1, 1904.

White, in his presidential address before the Institution of Civil Engineers, had forecast the use of the oil engine and the gas engine with the producer. He thought Mr. Seaton might find this come into operation sooner than he anticipated.

Mr. Evans said that the cost of fuel would be a bar to the application of the oil engine to big vessels.

Mr. J. E. Thornycroft also spoke of the difficulties of obtaining the necessary fuel for oil engines. At present, the demand for hydro-carbon oils for illuminating purposes was very large, and if big ships were to take to using it, there would not be enough in the world to go round; so far as large powers were concerned, solid fuel would be the solution. Mr. Seaton had spoken of the difficulty of keeping a gas engine at work, but he would state that there had been engines of this type running for six months without stopping. (Mr. Seaton here interposed, asking for instances, which Mr. Thornycroft gave.) Continuing, the speaker said that the great question before marine engineers, in the application of internal combustion engines for heavy work, was, What form of producer could be used on board ship? We wished there had been some discussion on this subject. The gas engine, with producer, had been worked with tug boats on the Continent.

Water-Tube Boilers for Warships.—The Government has decided to install eight Babcock & Wilcox boilers to replace the Scotch boilers in the *Indiana* and four Babcock & Wilcox boilers on the monitor *Monterey*. The battleships *Vermont, Kansas* and *Minnesota* are also to be fitted with boilers of this make.

Trial Trip of the U. S. Protected Cruiser Tacoma.

The trial trip of the U. S. protected cruiser *Tacoma*, which took place in Santa Barbara channel, Cal., on November 30, 1903, was of special interest because this ship was the first of her class to make her contract speed of 16 1-2 knots. The trial speed for four hours was at the rate of 16.62 knots. The ship was built by the Union Iron Works, San Francisco, Cal., and is one of four built from the same plans. The designed horse power was but 4,500, but on trial the average developed was 5,233.5 I. H. P., while the speed was only a fraction in excess of the requirement.

The *Tacoma* is a shallow draft protected sheathed cruiser 292 feet length on the water line, 44 feet beam, 15 feet 9 inches draft and 3,200 tons displacement. Other particulars will be found in the data card on next page. She carries ten 5-inch quick firing guns, 50 calibres long; eight 6-pounder rapid firing guns; two 1-pounders; four machine guns and one field gun. A protective deck, varying from 1 to 2 inches thick on the slopes to 1-2 inch on the flat, is worked in. She is sheathed with hard wood over which is annealed copper sheathing which, with the shallow draft eminently fits her for service in tropical waters far away from dry docks.

UNITED STATES PROTECTED CRUISER TACOMA IN DRY DOCK AT SAN FRANCISCO.

MACHINERY.

The ship is propelled by two sets of four-cylinder, triple expansion engines placed abreast of each other with water-tight bulkhead between. The cylinders are 18, 29, 35.5 and 35.5 inches, and the common stroke is 30 inches. The H. P. is fitted with one piston valve, the I. P. with two piston valves and each L. P. has a

double ported slide valve; the arrangement of cylinders from forward aft is: forward L. P., H. P., I. P.; aft L. P. The crank shaft is made in two sections, of forged steel; when bolted together the cranks are at 90 degrees, the sequence being H. P.; I. P. forward L. P. aft L. P. The bedplates are of cast steel ∩ section, in three parts and bolted together. The engine framing, columns, connecting rods, piston rods, and eccentric rods are made of oil tempered nickel steel, tested for a minimum tensile strength of 90,000 pounds per square inch an elastic limit of 65,000 pounds of 15 per cent. reduction area; the elongation was 25 per cent. Stephenson valve gear and a steam floating lever reversing gear is used.

The circulating pump in each engine room is of the centrifugal type and is driven by a two-cylinder 6 by 6 by 6-inch engine. Each air pump is direct connected to the forward low pressure crosshead by levers and is 22 inches diameter by 10 inches stroke which discharges either into the lower filter tank or into a hot well tank some 12 feet above. An independent cylindrical steel plate condenser is placed in each engin room. All pumps are of the Davidson pattern. The water flows from the upper tanks by gravity through the feed water heater to the independent main feed pumps in the fire rooms with bypass around heater. The main feed pumps are 10 by 7 by 12-inch vertical double acting and are fitted with air chambers on suction and discharge ends to eliminate hammering.

MARINE ENGINEERING DATA CARD. **MAY, 1094.**

NAME—Tacoma. NATIONALITY—United States. TYPE—Protected cruiser.

LAUNCHED—1903. BUILDER—Union Iron Works. OWNER—United States Navy.

Length, load water line	292 ft. 0 ins.
Beam, extreme	44 " 0 "
Draft, normal	15 " 9 "
Displacement	3,200 tons
Immersed midship section	620 sq. ft.
Coal supply, normal	467 tons
Battery, main	ten 5-in R. F. G.
" secondary, eight 6-pdr. R. F.; two 1-pdr. R. F.; four colt; one 3-in. field.	
Complement	21 officers, 281 men
Engines:	two 4-cylinder triple
Cylinder diameters	18, 29, 35.5, 35.5 ins.
Stroke	30 "
Valves	11-in. piston; 1 on H. P., 2 on I. P.
I. H. P., designed	4,500
R. M. P., "	175
Cooling surface, 2 condensers,	6,004 sq. ft.
Shaft diam., line and propel., (hole 5 3-8 ins.)	9 ins.
Crank (hole 5 ins.)	9 1-4 "
Thrust (hole 5 3-8 ins) 14 ins. and 9 1-4 "	
Connecting rod, distance bet. centers	.67
Propellers: Built-up manganese bronze, 3 blades	
Diameter	10 ft. 0 ins.
Pitch (adjust. 10 1-2 ft. to 12 1-2 ft.), 11 " 6	
Area, developed	25.77 sq. ft.
" ratio developed to disc	33.8 per cent
Boilers: Type	6 Babcock and Wilcox
Steam pressure	275 lbs.
Tubes, each, 406 2-in.; 17 4-in.; length, 8 ft. 11 ins.	
H. S., total	13,200 sq. ft.
G. S.	300 " "
H. S. ÷ G. S.	44.
Weight, dry, total	71,860 lbs.
Speed trial	16.62 knots
I. H. P. trial	5234.
H. S. ÷ I. H. P.	2.52
I. H. P. ÷ G. S.	17.45

The auxiliaries include a very complete equipment of pumps, evaporators, distillers, auxiliary condenser, four direct connected dynamos, steam steering gear, and refrigerating system. Electric motors are used for operating the ventilation fans, bulkhead doors, and two gypsey heads.

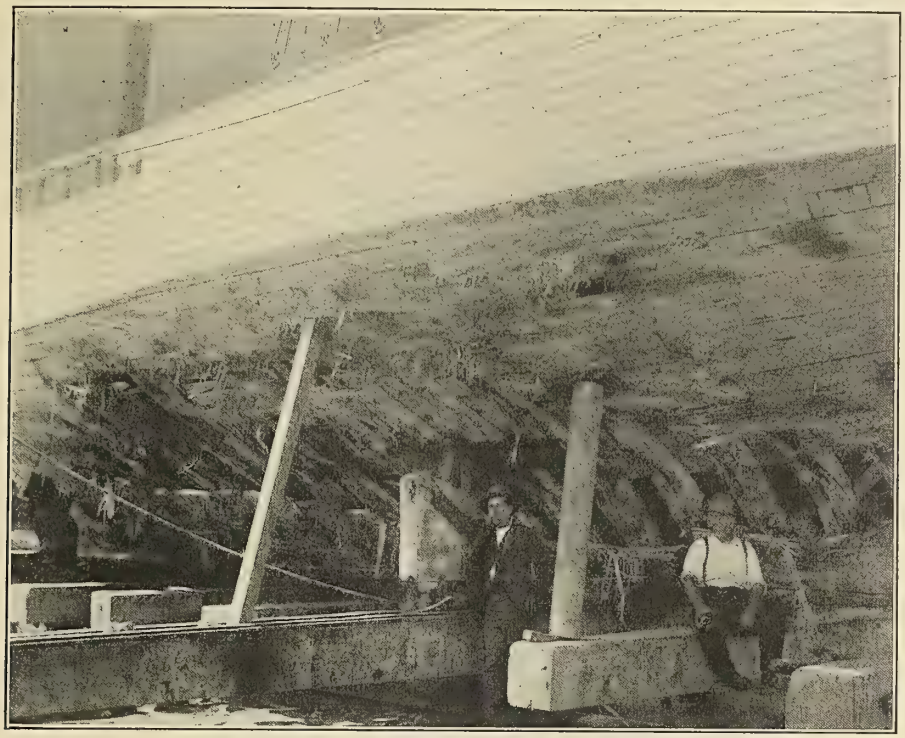
The propellers are three-bladed and of the built-up type of the dimensions given in the table. All castings are of manganese bronze and all surfaces are tinned. The tensile strength of the bronze is 55,000 pounds, elastic limit 20,000 pounds and elongation 20 per cent. Fairwaters are placed at the stern tubes on both sides of the struts and at the propellers.

There are two fire rooms, the forward one containing four water tube boilers and the aft one two boilers. All boilers are of the Babcock and Wilcox marine water tube type. Steam is carried at 275 pounds pressure. The closed fire room system of forced draft is used, two blowers being placed in the forward fire room and one in the after fire room and each is driven by a single valve compound engine. Each boiler has 406 2-inch tubes of No. 8 B. W. G. and seventeen No. 6 B. W. G. 4-inch tubes of 8 feet 11 inches length. The heating surface of each boiler is 2,200 square feet and the grate surface 50 square feet, and the total weight of the six boilers, dry, is 71,860 pounds. In each fire room is installed a patent ash ejector, also a two-cylinder ash hoist engine capable of raising a 300-pound bucket of ashes in five seconds. The boilers are tested at 400 pounds hydraulic pressure and 325 pounds steam pressure.

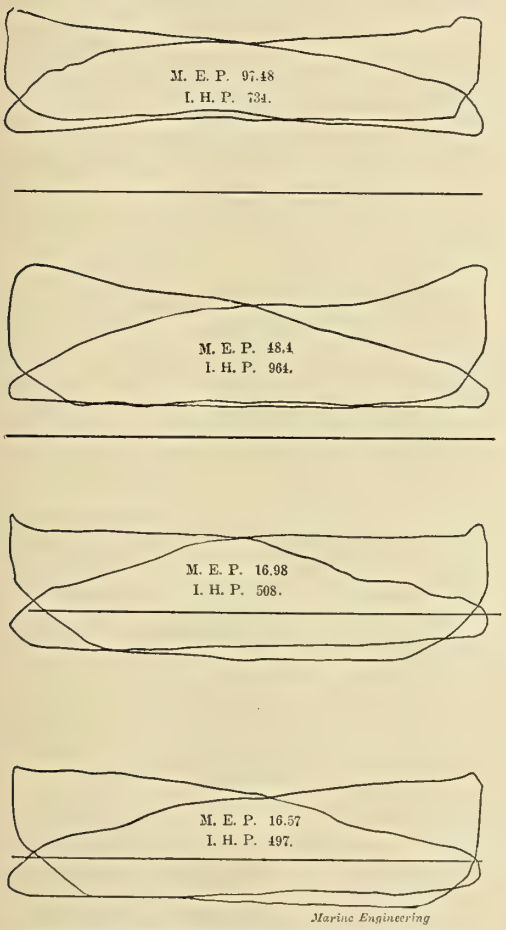
TRIAL.

On November 30 the ship crossed the starting line of the trial course, which was 33 nautical miles long, ran at full speed the length of the course, making the turn and return trip at full speed with engine running cool and boilers steaming well. An appliance which was found of great service in indicating the time for coaling each furnace consisted of a dial placed in each boiler room. On these dials were indicated by numbers the different furnaces and at the time for firing a furnace an electric light would be turned on at the dial behind the number of that furnace. The frequency of coaling was regulated by the engineer in the engine room. Following are the data for the run and for one set of cards from the port engine.

	AVERAGE FOR RUN.	FOR CARD ON PAGE 215.
Steam pressure, boiler	275 lbs.	278 lbs.
engine	245 "	250 "
Vacuum	27¼ in.	27 in.
Cut-off on all links	.7	.7
Throttle	Wide open.	
Revolutions, main engines	198.5	201.6
circul. pump	220 to 330	
blowers	640 to 810	
Strokes, main feed	18 to 36	
bilge	39	
water service	30.	
Temperature, engine-room	89 deg.	
fire-room	100 "	
injection	72 "	70.
discharge	108 "	112
feed	107 "	102
uptakes	550 "	
I. H. P. main engines	5233.5	2703
M. E. P. refd to L. P. start	25.6 lbs.	
end	40.5 "	
Speed	16.62 knots	



DAMAGE DONE BY CORAL REEF TO SCHOONER YACHT SYLPH.



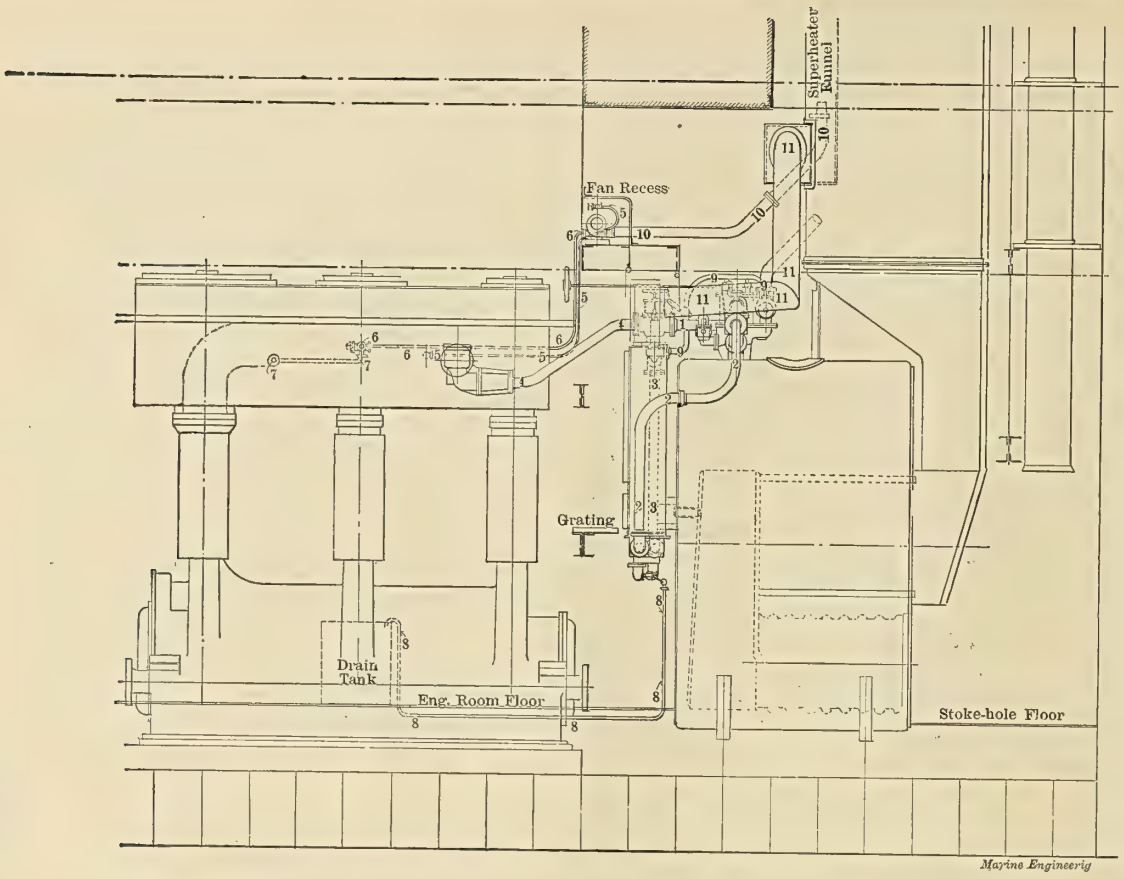
SET OF INDICATOR CARDS TAKEN FROM THE PORT ENGINE U. S. S. TACOMA.

Effect of Stranding on Coral Reef.

The accompanying photograph plainly shows the grinding effect that a coral reef has on the bottom of a wooden boat. As may be seen, the planking and frames are ground into fibre. The subject is the schooner yacht *Sylph,* as she was hauled out on a marine railway at Key West after stranding on a coral reef on February 18, near the entrance of the southeast channel to Key West.

The *Sylph* was sold as she lay on the reef, but was not hauled off until two weeks later, and then empty barrels were placed under her decks and her ballast taken out. The yacht, which was built at Port Jefferson, Long Island, in 1889, is of 68.32 gross tons, 72 feet 6 inches in length, 22 feet 5 inches beam and 8 feet 9 inches deep. She was owned by Mr. J. Birkly, of Minneapolis.

The "Technical World."—A new magazine, issued by the American School of Correspondence at Armour Institute of Technology, Chicago, Ill., appeared in March, and it is appropriately named the *Technical World.* In the editorial announcement it is stated that the purpose of the magazine is to render every assistance to students and to men interested in technical matters in general. It is promised that each issue will contain articles from eminent men, and that the advances in the branches of engineering, architecture, and textile manufacturing will be carefully reviewed on its pages. The first number is, indeed, very creditable, and, if it may be taken as an exponent of the future editions, the editorial success of the magazine is assured. The leading article is on radium, profusely illustrated, and written by Robert A. Millikan, of the University of Chicago.



ELEVATION OF ENGINE AND BOILER ROOM, SHOWING STEAM PIPING AND ARRANGEMENT OF SUPERHEATER.

The Central Superheater.

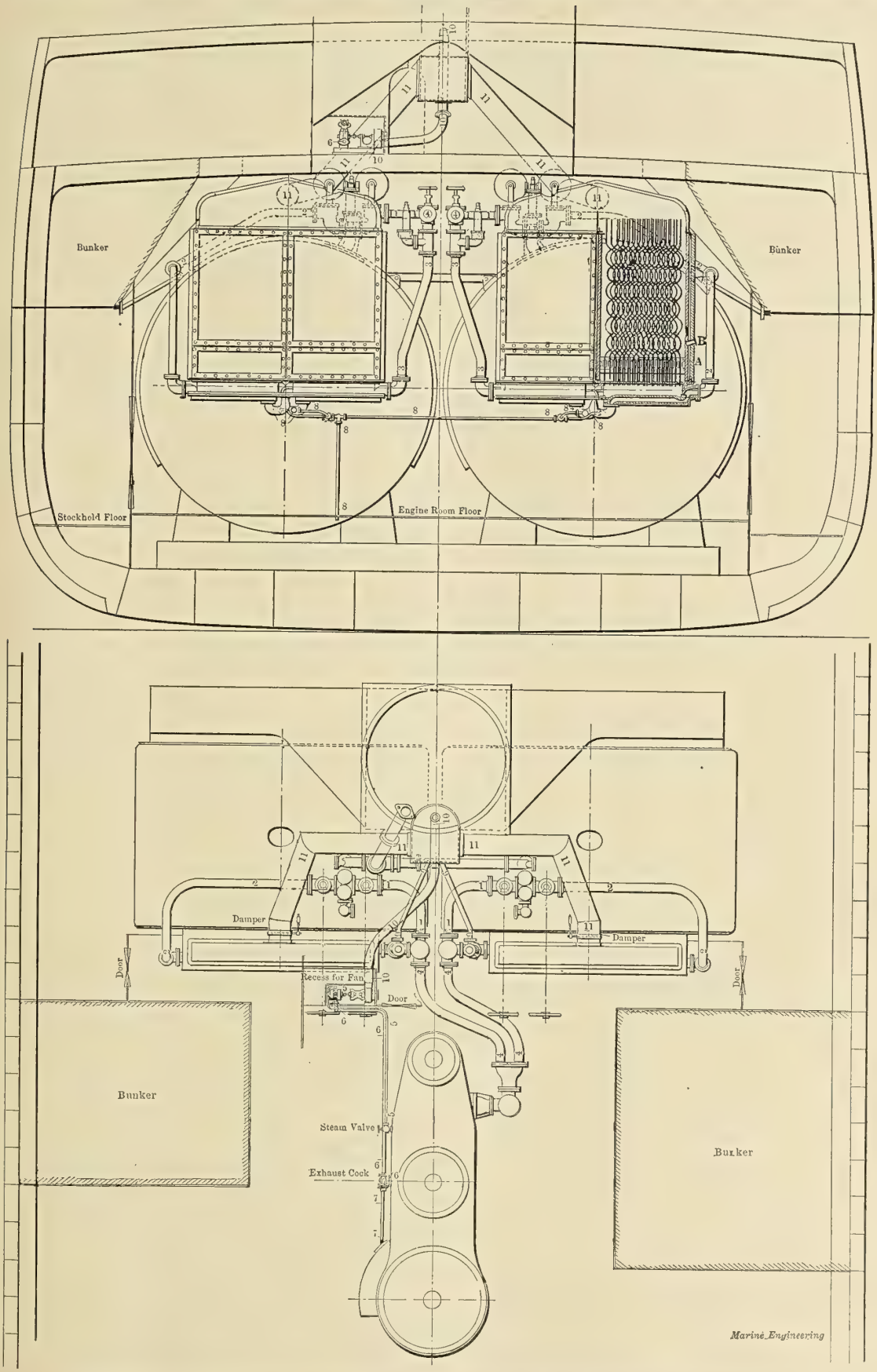
Nearly three years ago there was described in this paper the machinery of the famous Inch Line steamers *Inchmarlo* and *Inchdune,* which gave such remarkable results for economy on trial and in service. It will be recalled that steam superheaters of waved tubes were placed in the uptakes of the boilers, and above these were fitted the air heaters for the induced air system for supplying the furnaces.

Concerning the performance of the *Inchmarlo,* the builders and owners have given out a statement of a 380-day voyage recently completed nearly around the world, during which the coal supply was obtained just as the ship was able to get it at the various ports of call. The average consumption, with a carrying capacity of 5700 tons and an average speed of 9 knots, was 15 1-4 tons per day of 24 hours. It is also stated that the average horse power was in the neighborhood of 1,400 I. H. P. This works out to practically one pound of coal per I. H. P. per hour, a feat in coal consumption which in marine practice has hitherto never been touched. The figures are based on the owner's statement of the coal actually paid for during the voyage.

The ship was engined by the Central Marine Engineer Works of West Hartlepool, England, which company has recently installed the machinery on three new steamers, the *Queensborough,* the *Atlantic* and the *Britanic.* The first of these three has been in service several months, and a saving of about 10 per cent. in fuel is being effected. This is attained by increasing the temperature of the steam to nearly 500 degrees Fahrenheit, the boiler pressure being 160 pounds per square inch, corresponding to a temperature of 370 degrees Fahrenheit. In the *Inchmarlo* the steam pressure carried was 267 pounds and superheated to 57 1-2 degrees Fahrenheit, but it was later found that by reducing the pressure and increasing the superheat greater economy was effected. It is the builders' experience that with boiler steam at about 160 pounds pressure, every 10 degrees rise in temperature of the steam results in an economy of 1 per cent. This, while a rough-and-ready rule, is considered by the builders to be a perfectly correct one through their experience on several ships fitted with their superheaters.

The form of heater now being installed on the *Atlantic* and *Britanic* is herewith illustrated on pages 216 and 217, where are given the sides and end elevation of the boilers as well as plan.

The boilers and engine are placed in the same compartment, as shown in the longitudinal elevation, and the superheater is placed at the back of the boilers and connects with the top of combustion chambers through openings A, A. The casing containing the coils is heavily insulated with asbestos, and at the upper end has a funnel, 11, leading into the separate funnel placed inside the main stack. Steam may be taken direct from the boilers through pipes, 1, 1, but ordinarily it is led through pipes, 2, 2, to the headers at the base of superheater. The superheaters are drained by pipes, 8, 8, into a drain tank placed in the engine room. The steam passes up through the outboard nests of bent vertical pipes to the top headers, thence across to the inboard



ELEVATION AT BACK OF BOILERS LOOKING FORWARD, AND PLANS SHOWING ARRANGEMENT OF SUPERHEATER.

nests and down again. From the second bottom header it is carried through pipes 3, 3, to the main steam pipes, 4, 4. A small steam motor, which is really a triple expansion balanced turbine, and called the Central Rotor, is placed in a recess above the port boiler for driving a fan to induce a draft through the superheater. This fan was not installed on the *Queensborough,* where natural draft was relied upon, which was not altogether satisfactory during all conditions of wind and weather. This rotor is the only point of difference between the installations on the *Queensborough* and the later two ships. By means of this fan and the dampers in the funnels, 11, 11, the draft through the superheater may be controlled perfectly. A peep-hole is placed on the side of the superheater at B, and the front of the casings may be readily removed to inspect the tubes.

The steam for the turbine or rotor is taken from the intermediate pressure valve chest through valve and pipe 5, and the exhaust is returned to either the low-pressure receiver through 6, or to the condenser, through 7. Waste steam pipes, 9, are fitted for carrying off steam from the safety valves placed on the superheaters.

DESIGN OF A 6-HORSE-POWER, TWO-CYCLE MOTOR.

BY H. B. MAXWELL.

The two-cycle motor has until recently been in nearly entire possession of the field for boat propulsion, and now this field is being encroached on by the four-cycle automobile engine, the claims being made that the latter is more reliable in running and more economical of fuel for a given horse power. That this is a fact when the average two-cycle motor is considered cannot be disputed, but some of the brightest engineers connected with the gas motor industry have for some time past been giving their attention to the two-cycle motor, and by proper attention to details, have produced a machine that is claimed to be the equal of the four-cycle motor in regard to reliability and fuel economy.

The simplicity of the two-cycle motor is a great advantage, both from the point of cost of construction and maintenance; there is also far less to look after if the motor goes wrong. Any well constructed engine, either a two or four-cycle, will run satisfactorily if the following points be obtained: good compression, a proper mixture of gas or gasoline vapor and air, and a good hot spark properly located. With the two-cycle motor aside from proper lubrication these three points are all that need attention if the motor goes wrong; in a four-cycle motor there are in addition the valves, valve springs, cams, gears, etc., that may all be responsible for trouble, and cause the motor to balk or to loose power. We will now note a few points in two-cycle motor construction that have proved serious obstacles to many builders of this type.

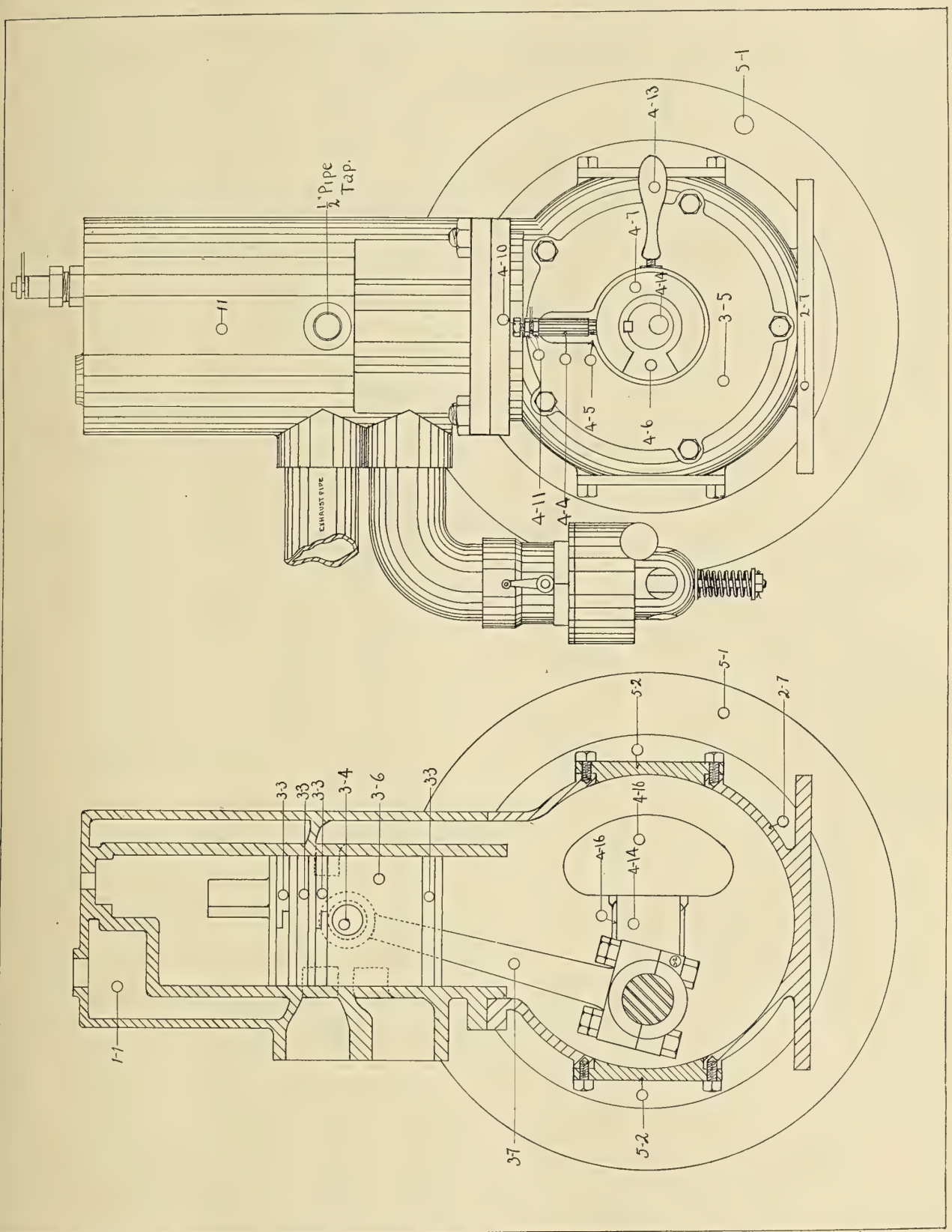
First and foremost, builders of two-cycle type have seldom or never attained the compression pressure common in the four-cycle type, and thereby the power of the two-cycle is but little if any greater than the power of a four-cycle motor of equal cylinder dimensions. Then again, the ports seem to have been designed without any regard to cylinder diameter and piston speed. In several makes the ports were so small that 350 revolutions per minute for medium size, and 500 to 600 for small size motors was about the limit of rotative speed when running light, and when under load, this speed frequently fell off ten to thirty per cent. In such cases had the ports been properly proportioned, the rotative speed could have been easily doubled and the torque would have held up in nearly constant proportion to the increase in speed.

Another serious defect results in placing the ports in the cylinder walls, and in not giving the proper lead to the exhaust port so as to reduce the pressure and allow the products of combustion to escape before the by-pass port from the crank case is opened. The deflector plate on top of the piston is another stumbling block, many being little if any higher than the width of the inlet port. This allows the incoming charge to pass over the deflector and a large portion of it to escape through the exhaust port—hence the waste of fuel usual to this type of motor. The deflector plate should be cast integral with the piston, and be at least twice as high as the width of the inlet port; in order to do this and have high compression the head will have to be recessed to allow the deflector plate to clear when the piston is at the top of the cylinder. By making the stroke a little longer than the bore and having a deflector plate of proper length, a two-cycle motor may be slowed down and run at a much slower speed than usual by means of the throttle, thus making it a very flexible source of power and approaching the steam engine in this respect.

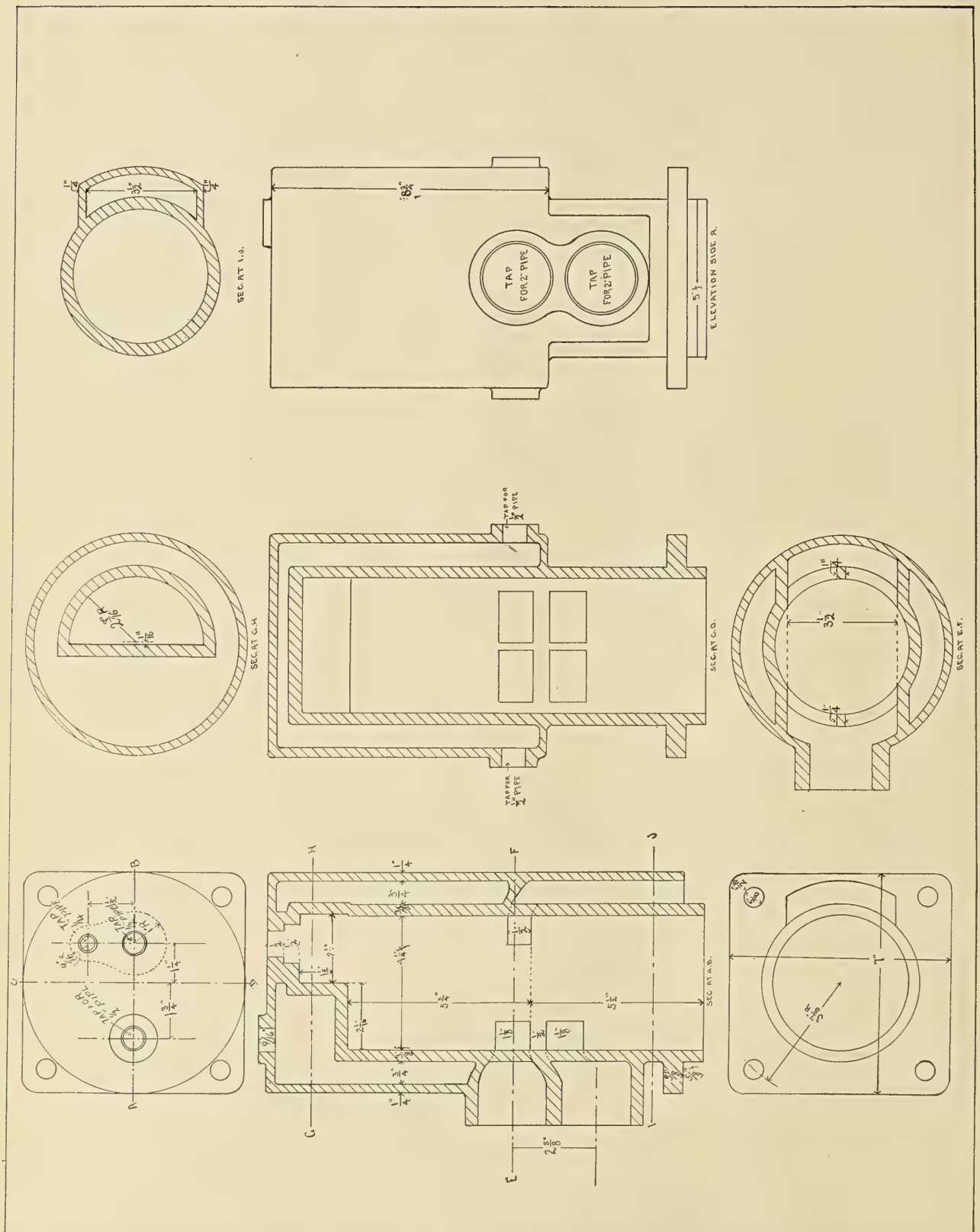
If the mixture and igniter are working right, there need be no fear of base explosions. The jump spark system of ignition is now used successfully on two-cycle motors and in some respects is preferable to the make and break igniter, the main one being in avoiding moving parts inside of the cylinder. It must be remembered that the spark plug must extend into the combustion chamber and not be in a pocket or side chamber, else when running throttled there will not be sufficient compression to force the explosive mixture back far enough to reach the igniter points, and misfires will result; the unexploded charge will explode in the muffler and give an exceedingly loud report similar to a cannon when fired. This will in all probability give a crank case explosion also and stop the engine unless it has a very heavy fly wheel, and in any event it causes a serious loss of power.

The crank case should be designed so as to have as little space as possible and still give proper clearance to the moving parts therein. For high speeds it is better to have the inlet port in the crank case opened by the piston, although a poppet valve inlet placed on the by-pass port as near as possible the point where it enters the cylinder, will be found to work well, yet this adds a valve and spring and gives one point of trouble borrowed from a four-cycle motor and it is not needed; it also adds to the cost of manufacture.

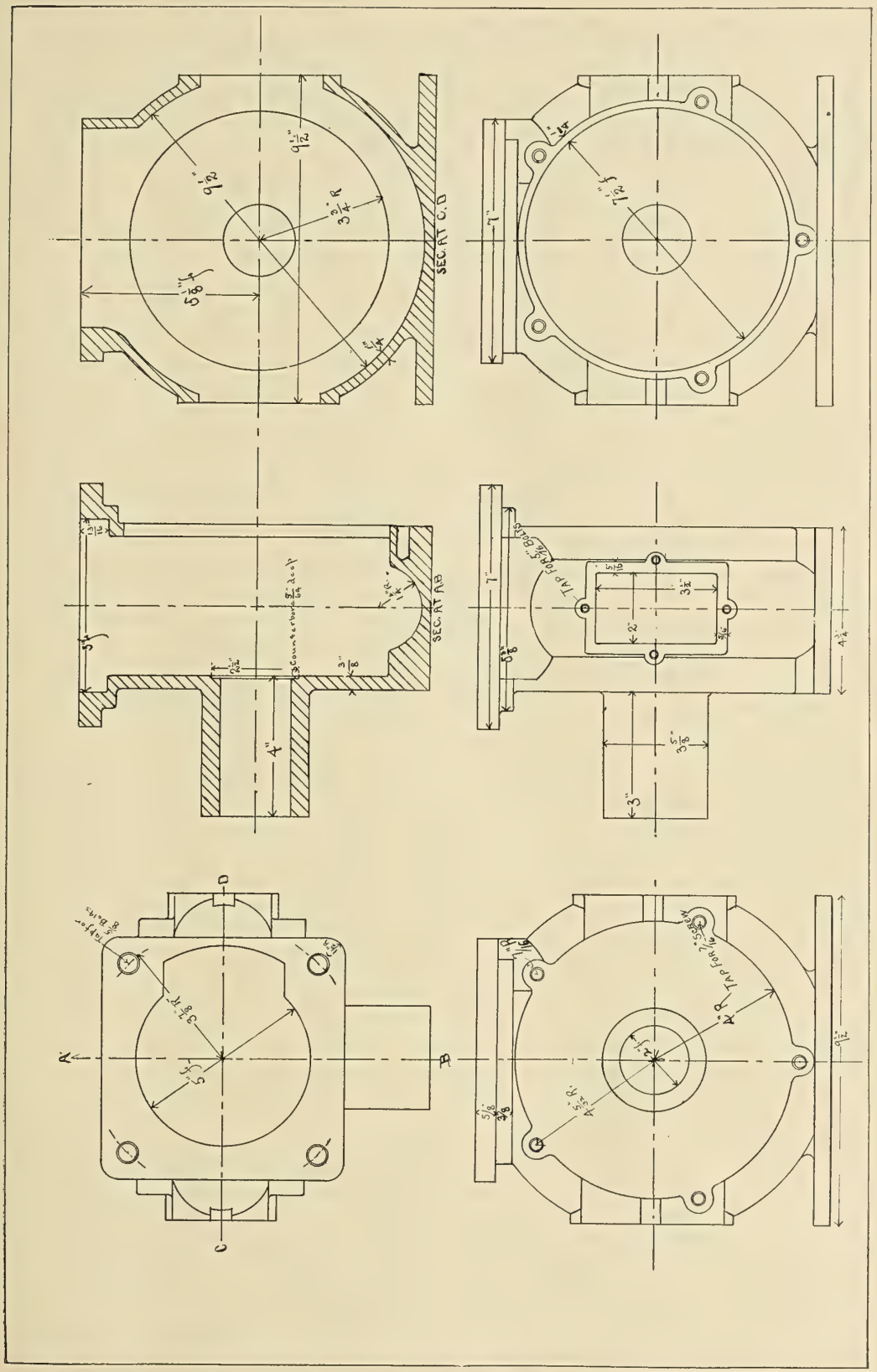
Herewith is given a complete set of working drawings for a 4 1-4 by 5-inch two-cycle motor that if well made and fitted as per instructions given above, will develop 6 brake horse power at 750 revolutions per minute. Later sketches will be given of special tools for doing the work right and attention will be called to the parts that require special care to produce good results.



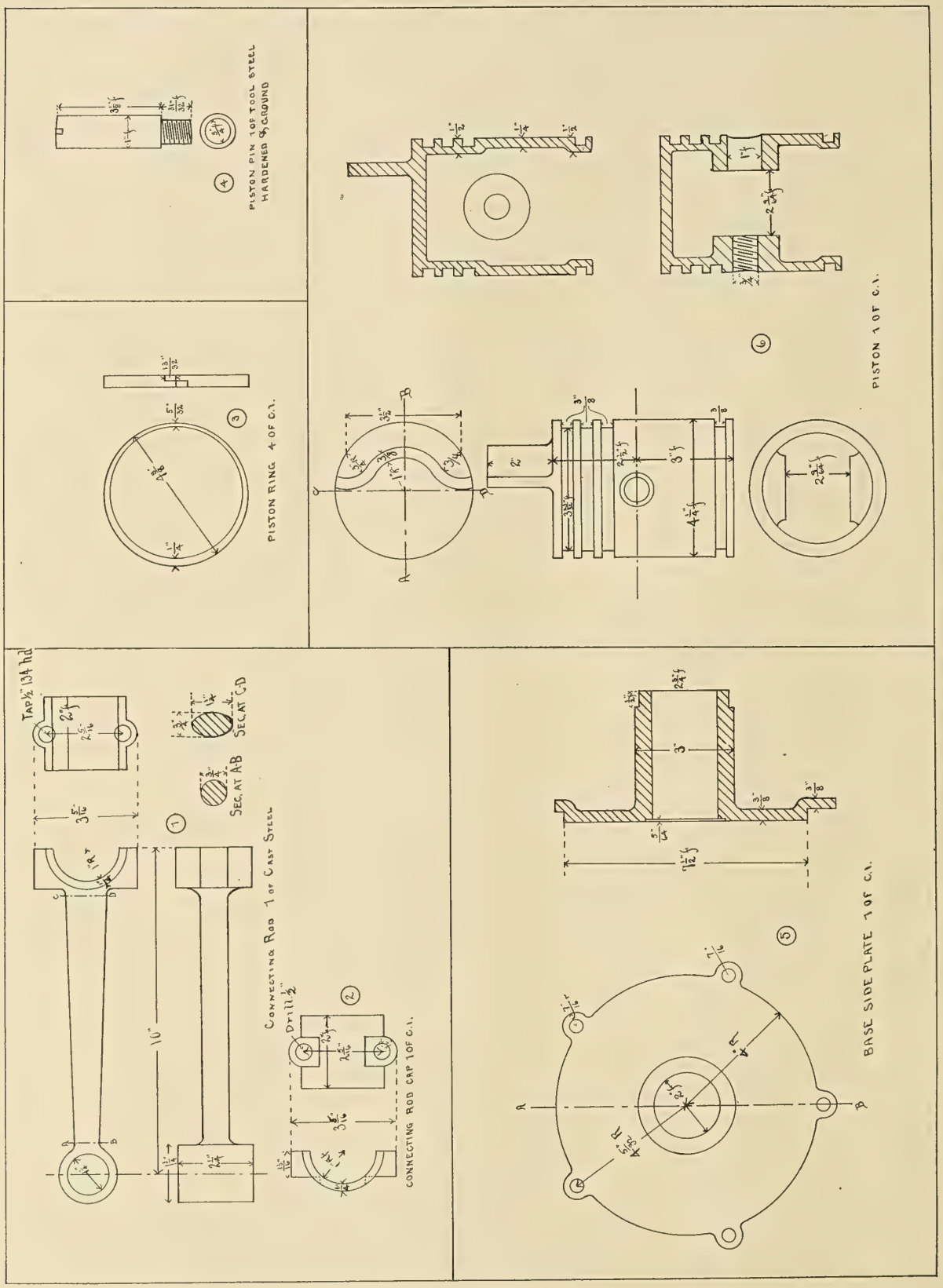
TWO-CYCLE MARINE MOTOR, 4 1-4 INCHES BORE BY 5 INCHES STROKE.



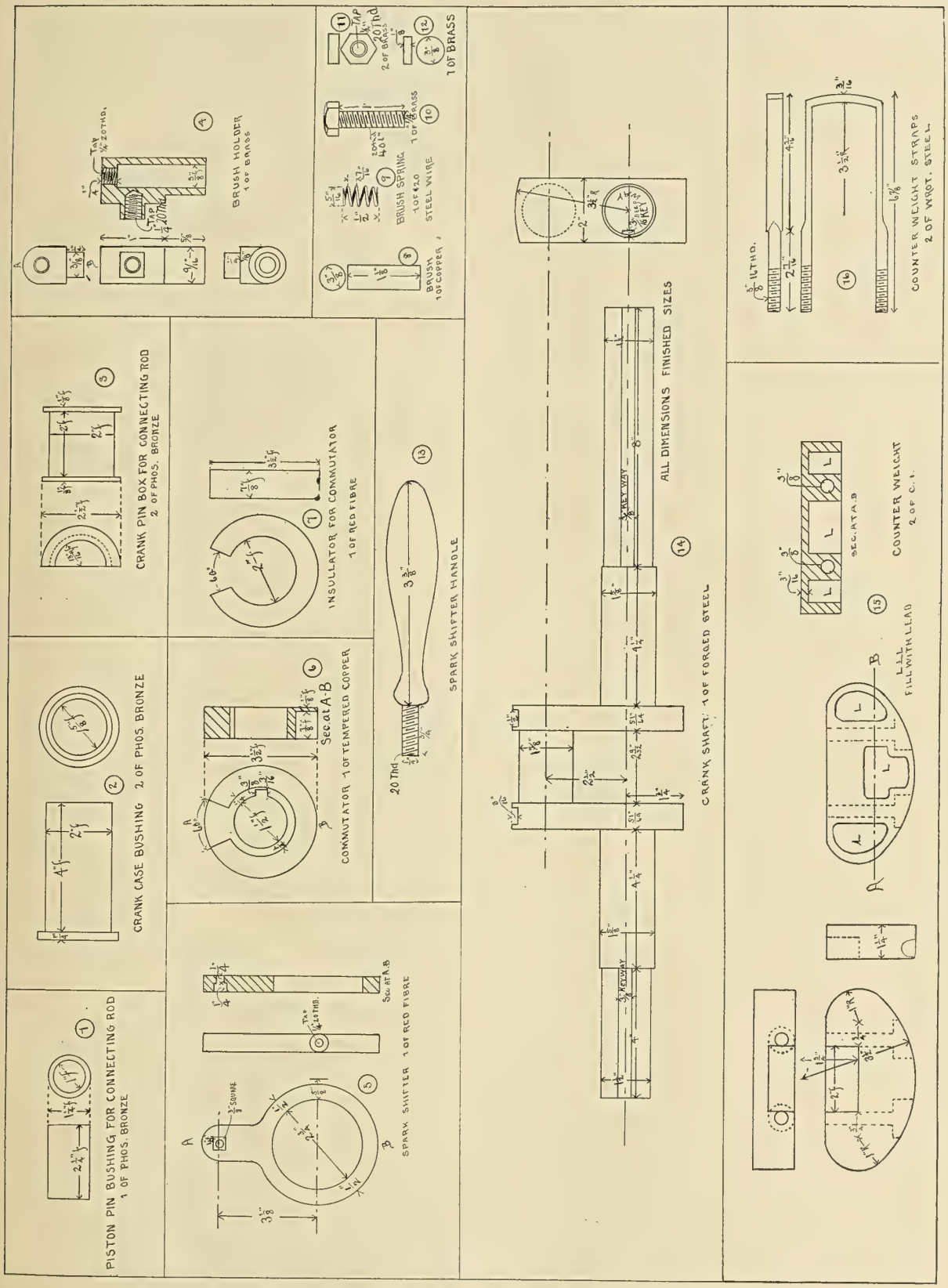
CYLINDER DETAIL, 4 1-4 BY 5 INCHES TWO-CYCLE MARINE MOTOR.



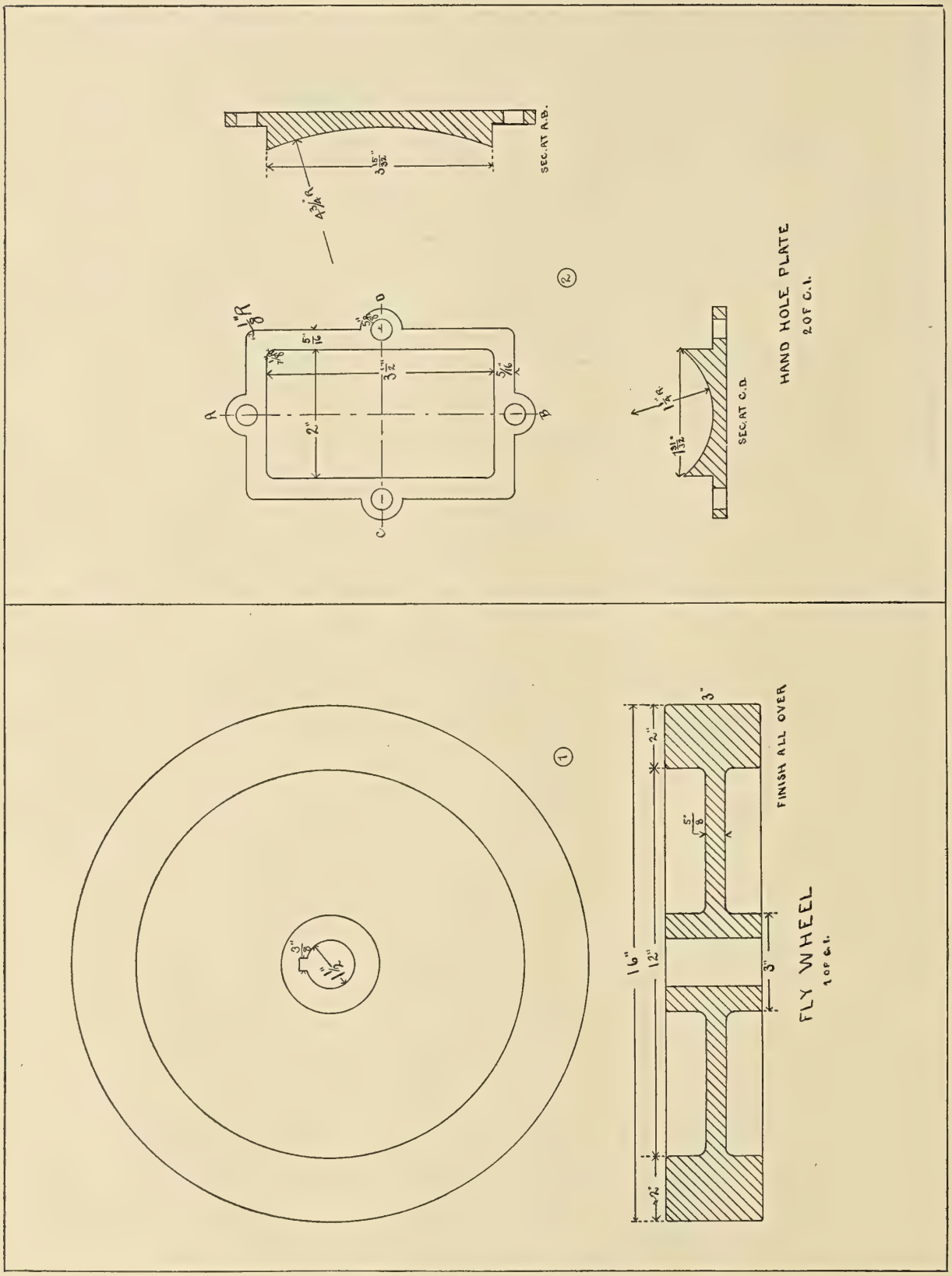
BASE DETAIL, 4 1-4 BY 5 INCHES TWO-CYCLE MARINE MOTOR.


PISTON PIN 1 OF TOOL STEEL HARDENED & GROUND
PISTON RING 4 OF C.I.
PISTON 1 OF C.I.
CONNECTING ROD 1 OF CAST STEEL
CONNECTING ROD CAP 1 OF C.I.
BASE SIDE PLATE 1 OF C.I.

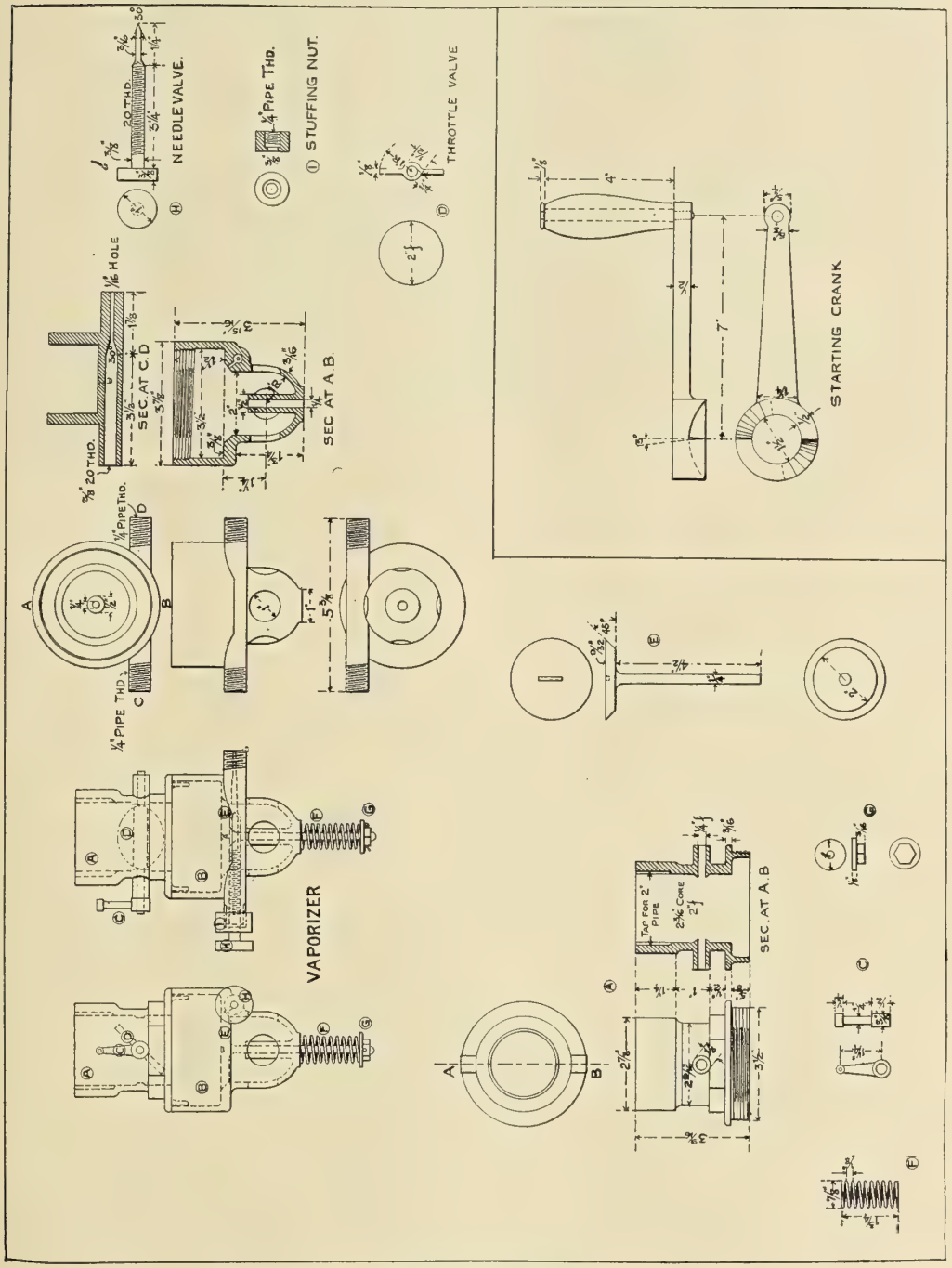
CONNECTING ROD, BASE SIDE PLATE AND PISTON DETAIL 4 1-4 BY 5 INCHES TWO-CYCLE MARINE MOTOR.



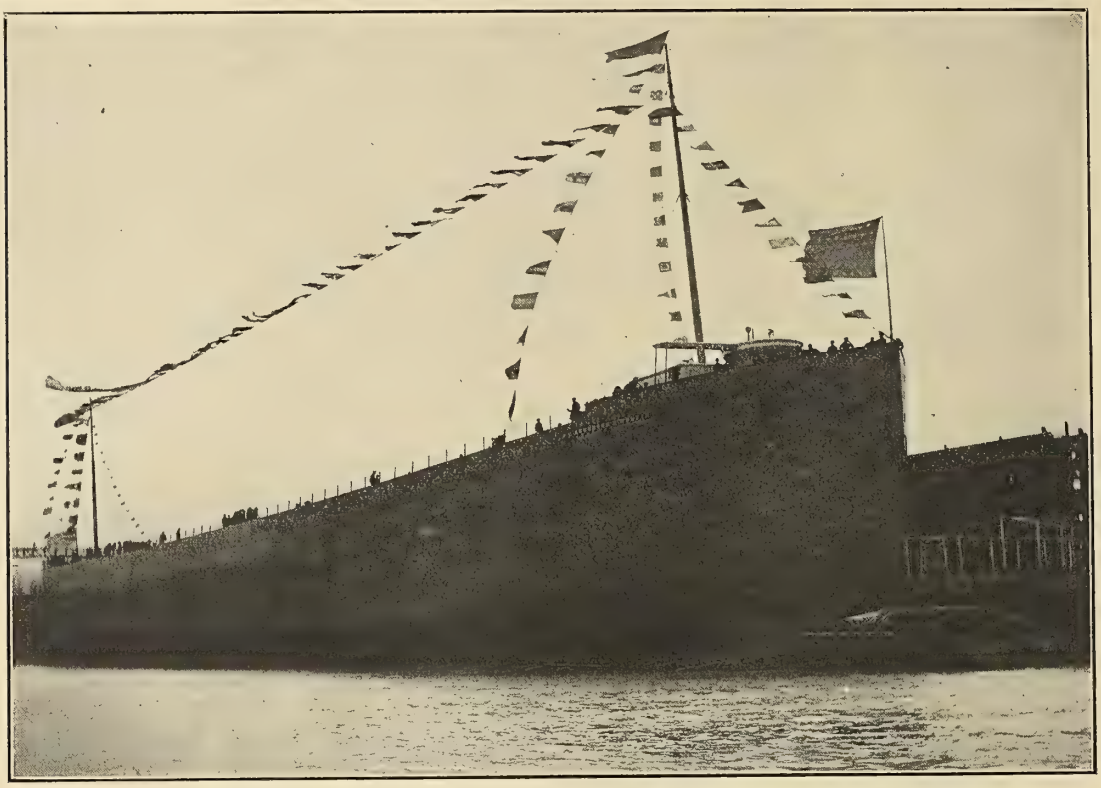
SHAFTING AND SUNDRY DETAILS, 4 1-4 BY 5 INCHES TWO-CYCLE MARINE MOTOR.



FLY WHEEL AND HAND HOLE PLATE, 4 1-4 BY 5 INCHES TWO-CYCLE MARINE MOTOR.



VAPORIZER DETAIL, 4 1-4 BY 5 INCHES TWO-CYCLE MARINE MOTOR.



LAUNCHING THE AUGUSTUS B. WOLVIN, THE LARGEST SHIP OF THE GREAT LAKES.

STEAMER AUGUSTUS B. WOLVIN OF THE GREAT LAKES.

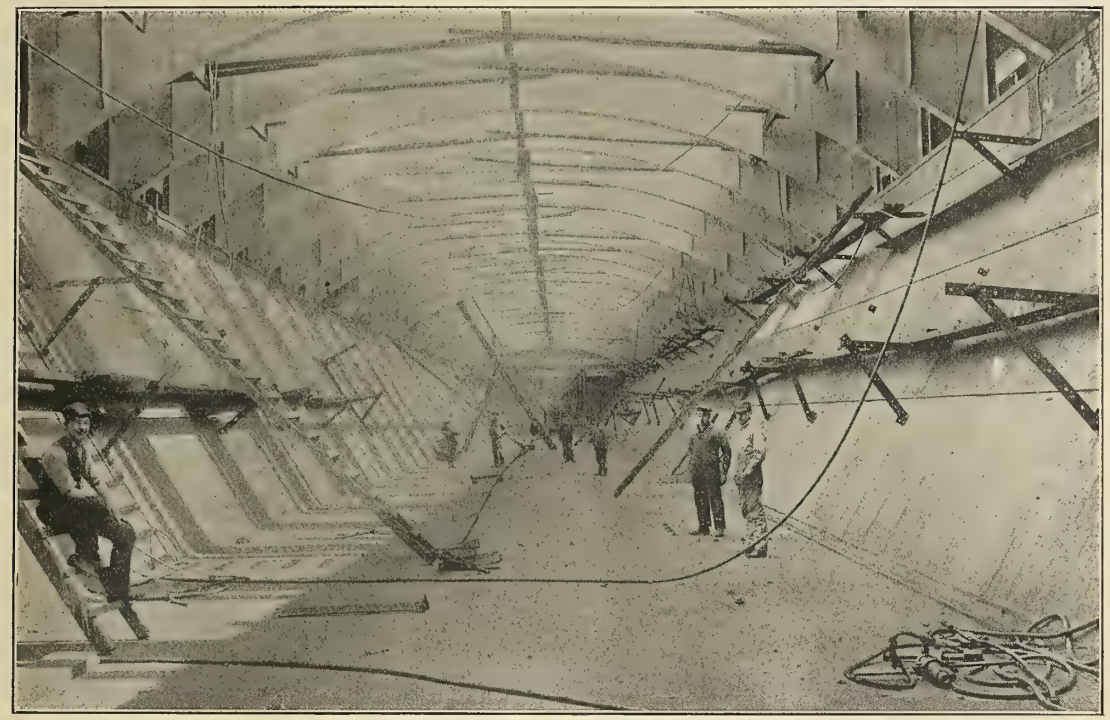
The *Augustus B. Wolvin*, the largest vessel ever built anywhere to navigate fresh water, was launched from the Lorain yard of the American Shipbuilding Company on April 9. The new steamer will run on the Acme Steamship Line of which Mr. Wolvin, for whom the vessel is christened, is a large owner. There are very few ocean vessels that are purely freight vessels that exceed her in dimensions, her length being 560 feet over all and 540 feet on keel, while the beam molded is 56 feet at the widest part, and a molded depth of 32 feet amidships.

The builders have incorporated in the design of this ship several new and interesting features, the principal one of which is probably the shape of the cargo hold. This is built in the form of a hopper, with sides that slope from the main deck down to the tank top and the ends built on the same slope. The hopper extends in one continuous length of 409 feet without bulkheads or divisions of any kind, and in width it measures at the top 43 feet, and at the bottom 24 feet. The space between the sides of the ship and the sides of the hopper is used for water ballast, so that the water ballast, as well as being in the usual double bottom underneath the hopper, extends up the sides to the height of the main deck stringer. This construction was adopted to accommodate the use of automatic clam shells in unloading the cargo and while it serves this purpose, it also serves to make a stronger vessel.

Another feature of the construction is the fact of the ordinary hold stanchions being dispensed with, and in their place a system of girder arches is substituted to support the upper deck as well as the sides of the vessel. There are thirty-three cargo hatchways on the spar deck, each one measuring 33 feet by 9 feet in the clear, and spaced 12 feet apart centers, so that it will be possible for the clam shells to unload the vessel entirely without any hand shoveling. These hatchways are fitted with a patented system of steel plate sliding hatch covers, operated by steam engines and shafting, so that no manual labor is required for the opening and closing of the hatch covers. The spar deck is continuous and flush from stem to stern, and the only erections on it are the pilot house and texas forward, and the coamings around the engine and boiler opening and dining room skylight aft.

The water ballast space is divided into numerous compartments by water-tight athwartship bulkheads fitted at intervals of about 60 feet, and the total ballast capacity is about 8,000 tons of water. The cubical capacity in the cargo hold of this immense vessel is about 500,000 cubic feet, which is equal to 401,000 bushels of grain, or to 12,500 tons of coal. On the spar deck are six 8-inch by 10-inch single drum engines, carrying each a steel wire mooring line for the usual mooring and warping purposes. In fact, steam has been used wherever possible to displace manual labor. There is a steam windlass fitted for handling the two 8,000-pound stockless anchors, and a steam capstan on the spar deck aft. The ship will be fully equipped with electric lights throughout and has duplicate plants, so that there will always be one to fall back on in case of the other giving out.

In the forward end of the vessel, immediately under the pilot house and texas, there are five state rooms



VIEW IN CARGO HOLD OF THE STEAMER AUGUSTUS B. WOLVIN, SHOWING INNER SIDE PLATING, DOUBLE BOTTOM AND ARCHED GIRDER BEAMS.

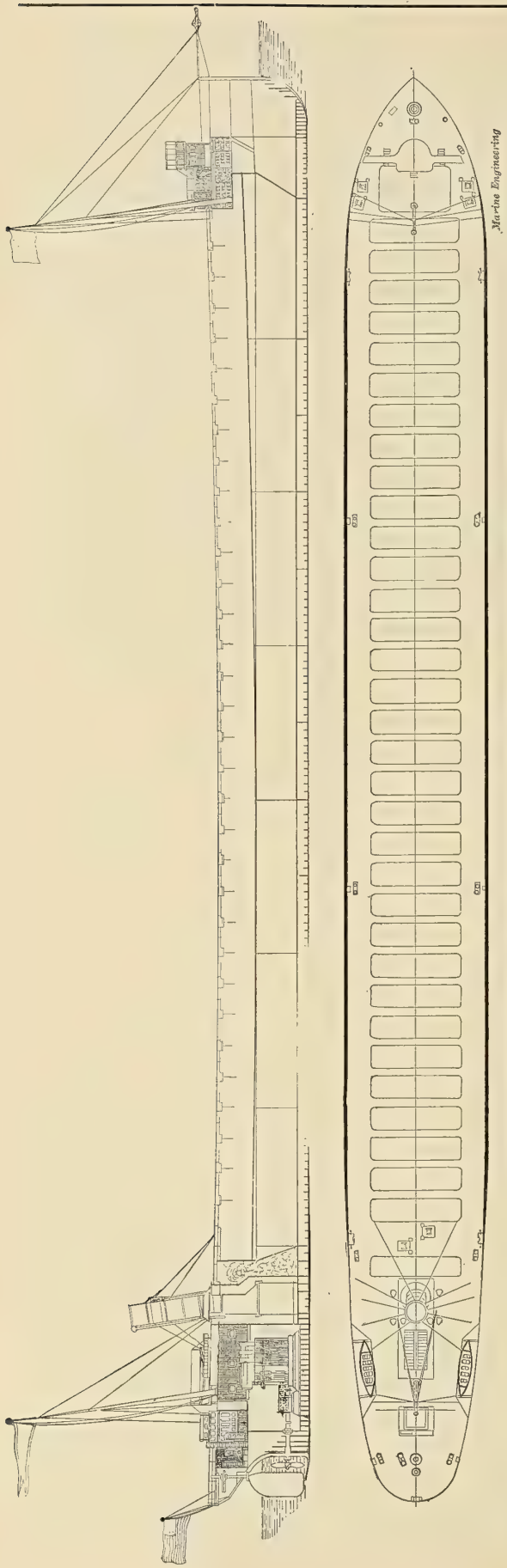
for owners and their families, also accommodations for their private galley, dining room and social parlor, and also two toilet rooms. They are entirely set apart from the crew's quarters and will be luxuriously furnished and fitted out. The ship's officers are accommodated on the deck immediately below the owner's quarters, and the engine room officers are quartered alongside of the engine at the after end of the vessel, where is also located the kitchen, dining room and mess room for the crew.

The propelling machinery, as is usual in Lake vessels, is located in the extreme after end of the boat. The main engine is of the quadruple four-crank type, with cylinders 18 1-2, 28 1-2, 43 1-2, and 66 inches diameter, each having 42-inch stroke of pistons, and they are designed for an indicated horse power of 2,000 when making 80 revolutions per minute. The cylinders are arranged from forward in the following order: High pressure, first intermediate, second intermediate, and low pressure. The high pressure is fitted with a liner secured in the usual way. The valves of the high, first and second intermediate are of the piston type, placed in front of their respective cylinders, and driven by Joy radial valve gear. The low pressure cylinder is fitted with a double ported slide valve on the after end, operated by double bar Stephenson link motion.

The bed-plate is of the girder type, of box section, in two pieces, bolted together, and has five main bearings lined with white metal. There are four back and five front cast iron columns, the former acting as guides for the crossheads. The piston rods are of steel 5 3-8 inches diameter, and the connecting rods of hammered iron 9 feet long between centers, with wedge adjustment at top, and T ends with bolts at bottom. The crossheads are of cast steel, keyed to piston rods and fitted with steel crosshead pins, secured with double taper and nut. The slippers are of bronze of large surface and easily adjustable. The crank shaft which with its four cranks is built without couplings, is 12 1-2 inches diameter. The crank pins are each 12 1-2 inches diameter by 13 1-2 inches long. The thrust is of the "horseshoe" type with six go-ahead collars and five backing. The engine is fitted with a direct acting steam, and a hand, worm reversing gear, also a steam turning gear at aft end of thrust shaft. The propeller is four-bladed cast steel, of sectional type. The outboard bearing is 13 inches diameter by 4 feet 8 inches long, filled with lignum vitæ.

The boilers, two in number, are of the Babcock & Wilcox type, and placed with a 12-foot space between them, to fire athwartships. The working pressure is 250 pounds per square inch, and the steam is superheated, the superheater being placed on top of boiler proper. The boilers are fitted with the mechanical stoker built by the Duluth Stoker Company, the coal being fed into hoppers, passing from thence on to traveling grates, the ashes being deposited at the back of boilers and discharged overboard by means of steam driven elevators. The boilers are fitted with Ellis and Eaves induced draft, having two 7 feet 6 inches diameter fans driven by double 6-inch by 5-inch high-speed engines.

To purify and heat the feed water before reaching the boilers, two Learmonth purifiers are fitted, also a large heater into which all the auxiliaries exhaust. There are the following auxiliaries in the engine room, the pumps, all being of the Blake type: One vertical cross compound simplex air pump; two horizontal cross



INBOARD PROFILE AND DECK PLAN OF THE GREAT LAKES FREIGHT STEAMER AUGUSTUS B. WOLVIN.

compound simplex ballast pumps; one horizontal compound duplex feed pump; one horizontal duplex pony pump; one horizontal duplex bilge pump; one horizontal duplex cooler pump. Two General Electric generating sets of 15 k. w. capacity each for electric lighting. One Globe steam steerer, and one Sturtevant fan with attached engine for ventilating purposes.

The coal bunker is fitted in front of the boiler room and has capacity for about 350 tons of coal. In every respect the vessel has been fitted out and built to meet the most modern requirements of the Lake service and there is not the slightest doubt but what she will fulfil every anticipation made of her.

Lehigh University.—The Registry of the Lehigh University, South Bethlehem, Pa., just issued, shows the attendance of 615 students from 24 cities and 10 foreign countries. Among this number are 174 studying the course of mechanical engineers, in which marine engineering is offered as an option during the junior and senior years.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 91 vessels of 25,866 gross tons built in the United States and officially numbered during the month of March, 1904. The largest steel steam vessels included in these figures are: *Manchuria,* 13,638 gross tons, built at Camden, N. J.; *Umbria,* 4,803 gross tons, built in Cleveland, Ohio.

MARINE ENGINEERING DATA CARD. MAY, 1904.

NAME—Augustus B. Wolvin. NATIONALITY—American. TYPE—Great Lakes freighter.

LAUNCHED—1904. BUILDERS—American S. B. Co. OWNERS—Acme Steamship Line.

Length over all.....560 ft. 0 ins.
" keel.....540 " 0 "
Beam.....56 " 0 "
Depth.....32 " 0 "
Load draft, forward and aft.....21 " 0 "
Ballast.....8,000 tons (short) fresh water
Cargo capacity.....500,000 cu. ft.
Dead weight, carrying.....12,700 (short) tons
Coal bunker.....350 tons
Engine: Number.....one
Type.....quadruple
Cylinder diam.....18 1-2, 28 1-2, 43 1-2, 66 ins.
Stroke.....42 ins.
R. P. M., designed.....80
I. H. P.....2,000
Crank shaft, diameter.....12 1-2 ins.

Propeller: Diameter.....14 ft. 6 ins.
Pitch.....14 " 6 "
Area, projected.....61.64 sq. ft.
Boilers: Number of.....two
Type.....Babcock & Wilcox water tube
Working pressure.....250 lbs.
Tubes, size.....4 ins.
Steam drums.....one each
Mech. stokers.....Duluth
H. S., two boilers.....5,500 sq. ft.
G. S., " " .....150 " "
Induced draft.....Ellis & Eaves

PACIFIC STEAMSHIP QUEEN ARRIVING AT SEATTLE DAMAGED BY FIRE AT SEA.

Fourteen Lives Lost in a Fire on the Steamship Queen.

Fire swept the steamship *Queen*, of the Pacific Coast Steamship Company, off Tillamook Light, on the Coast of Oregon, early in the morning of February 27, 1904, and fourteen lives were lost. Ten who died were members of the crew, burned or drowned, while four were passengers. The flames were discovered in a stateroom on the port side of the saloon deck by the night watchman at 4.30 A. M. Word was at once carried to Capt. Cousins the captain sounded the fire alarm and summoned the crew on deck to fight the flames, which rapidly gathered headway, until the entire after part of the ship was a seething mass. Life preservers were distributed among the one hundred and forty passengers on board, and when it appeared that the ship could not be saved the captain gave the order for clearing away the boats, and the four boats on the weather or port side were lowered and three of the crew placed in each boat to bring it around to the lee side. Then the boats on the starboard side were filled with women and children and lowered. All got away safely except the last one which got under the guard and was smashed and capsized; the other boats went to the rescue of the passengers, and it is worthy to call attention that only one passenger was drowned, the others being members of the crew. There were about sixty people in all lowered into the different boats. The boats were in the open until 8.30 o'clock, when, as it was believed the fire was under control, the whistle of the ship was sounded for them to return, and at 10.30 all were on board, and the *Queen* proceeded on her journey to Port Townsend. Three of the crew who were asleep in the glory-hole were burned to death in trying to get out.

A heavy sea was running at the time of the accident and a small gale blowing from the southwest. The origin of the fire appears to be unknown, but it gathered force very quickly, and it appeared that the ship would have to be abandoned. All on board speak in highest praise of the captain and his crew for the splendid work in fighting the flames and looking after the passengers. There was no confusion among the crew or passengers. Smoke filled the engine and boiler rooms, so that it was with the greatest difficulty that engineers could remain on duty at the pumps. A list of the officers of the *Queen* is as follows: Captain, N. E. Cousins; first officer, Geo. E. Zeh; second officer, I. N. Rees; third officer, W. Jackson; fourth officer, F. Meyers; chief engineer, W. J. McCreedy; first assistant, W. E. Anderson; second assistant, C. Harland; third assistant, G. C. Bronson; purser, F. R. Wetmore.

The *Queen* was on her 505th voyage. She is a steel ship, built at Cramps' yard in 1882, and is 331 by 38 1-2 by 21.2 feet. She is driven by a set of triple-expansion engines. The fire completely destroyed, as shown in the picture, the after cabins and deck, but it is stated that the hull plating was intact. She is now in dock and has been surveyed.

Cunard Liners.—The Cunard Company has announced its decision to install steam turbines on the two projected 25-knot express steamers. Four shafts will be fitted—a turbine on each shaft.

MERCHANT CRUISERS AND STEAMSHIP SUBSIDIES.*

BY THE RIGHT HONORABLE LORD BRASSEY, K.C.B., D.C.L.

The Institution of Naval Architects is essentially a professional organization. It sometimes deals with administrative questions, and such questions are pressing at the present time. There will be little opposition to naval expenditure on the ground of excess. But we are inconsistent. There may be murmurs at increase of taxation. In the conditions, with which we have to deal—public revenues less elastic, and consols showing a heavy fall in price—it is for those who are most deeply convinced of the necessity for maintaining a powerful navy carefully to consider every means by which efficiency can be combined with economy.

We discussed auxiliary cruisers, or scouts, at Glasgow. Then, as now, the need for care in the application of resources, however ample, was recognized: Such care is even more imperative to-day.

The Navy estimates, lately laid before Parliament, have reached an unprecedented figure. Looking back over ten years, the votes have grown from 19,031,000*l.* in 1895-6 to 36,880,000*l.* for 1904-5. To this total we have to add the cost of works and fortifications in part provided for by loan, in part charged on Army estimates.

Let us trace the comparative growth of expenditure as given in the columns of *Engineering,* in a recent issue. Our total Navy votes for 1893-4 were 14,500,000*l.*, as against a total for France, Russia, and Germany of 19,750,000*l.* The votes for the three Powers are now 35,000,000*l.* The three Powers have increased their votes by 15,000,000*l.* a year The British expenditure has increased by over 22,000,000*l.* Our expenditure for manning and the maintenance of ships in commission far exceeds that of the three Powers. As our Reserves grow we may reduce our numbers for active service.

If we turn to new construction, the branch of our subject with which this Institution is alone in any way concerned, we have barely maintained a two-power standard. Expenditure on shipbuilding has largely increased in Russia and Germany. In France it has not diminished. Between 1897 and 1902 the expenditure in shipbuilding for the British Navy was barely equal to the combined expenditure of France and Russia.

The amounts to be voted must be determined by Parliament upon the advice of the Admiralty, and with adequate information as to the policy of foreign countries. In the appropriation of expenditure administrators responsible to Parliament must depend on the advice of experts.

Let us see how we stand in the relative strength of our battleships and cruisers. The well-known "Taschenbuch der Kriegsflotten," compiled by Lieutenant Brenco Weyer, gives a forward statement for 1908:—

Battleships: Less than 25 Years from Date of Launch.

	Ships.	Aggregate Tonnage.
Great Britain	59	880,000
Russia	29	348,000
France	29	325,000
Germany	23	265,000
Total	81	938,000

Cruisers: Less than 20 Years from Date of Launch.

	Ships.	Aggregate Tonnage.
Great Britain	71	686,000
Russia	17	131,600
France	28	251,900
Germany	12	91,500
Total	57	475,000

The tables show that our shipbuilding should be concentrated more largely on battleships, and their indispensable auxiliaries—the destroyers. Armed cruisers are necessary for the protection of commerce. They must be regularly-built vessels of war. Ships for scouting should be obtained as far as possible from the mercantile marine. Speed and coal endurance are the essential qualities. No vessels of war have as yet been equal to the ocean liners. The German ships have an ocean speed of 23 1-2 knots. The *Lucania* and *Campania* of the Cunard, and the *Oceanic* of the White Star Line, steam 21 knots. The *Teutonic* and *Majestic* steam 20 knots; the *Umbria* and *Etruria* 19 knots.

For keeping open lines of communication, Lord Charles Beresford told the Select Committee on Steamship Subsidies that the ocean liners are absolutely wanted. There were no other ships which could do the work required as well as the ocean grayhounds, built for speed in any weather.

Foreign countries look on their fleets of postal vessels as indispensable auxiliaries to their navies. They are liberal in subsidies. In proportion to the tonnage of their mercantile navies and the requirements of their fleets, they are more liberal than the British Government. The total annual payments, as reported by the Committee on Steamship Subsidies, are as under:

	£
British mail subsidies	756,580
Additional payment to Cunard Company	150,000
Admiralty subsidies	77,813
	984,393
French subsidies (including bounties for shipbuilding and navigation)	1,787,271
Russian subsidies	364,756
Austrian subsidies	318,983
Japanese subsidies (approximate)	750,000

Passing from subsidies for the ocean mails to payments for mercantile cruisers, the latest information is

*Paper read before the Institution of Naval Architects, London, March 23, 1904.

Turbine Steamers in Germany.—Two turbine steamers are now being built in Germany, one at Danzig and one at Kiel. The first is an Imperial Navy cruiser of about 2,000 tons gross and 10,000 horse power with four screws, and the other is a passenger steamer of about 500 tons gross and 1,200 horse power with three screws.

given in a return recently presented to Parliament, on the motion of Earl Spencer. The total amount which had been paid for subventions is 712,376*l.*, the earliest agreement being dated May 14, 1888. The total number of ships subsidized is twenty-eight, including the *City of New York* and the *City of Paris*, which have since passed under the flag of the United States. The original agreements with the Admiralty did not provide effectively against the transfer of the subsidized vessels to foreign flags. Nine ships only in the list have a speed of 19 knots and over. The ships employed as the scouts or look-out vessels of the fleet should, it is reasonable to assume, have a speed at least equal to the sea-speed of a first class cruiser.

If the engagements had been such as to secure that no subsidized vessel could hoist a foreign flag without the consent of the Admiralty, and all the ships had a sea-speed of 20 knots, the payments might not be regarded as unduly onerous. The expenditure on subsidies for the twenty-eight ships does not exceed the cost of a single cruiser of the County class, of 9800 tons, with a speed of 23 knots on the measured mile, but with a coal capacity of not more than 800 tons. The cost of a second class cruiser, of 5880 tons, measured mile speed 21 knots, and coal supply 500 tons, rises as high as 437,000*l.* For the four first class cruisers of the *Black Prince* class, recently designed by Mr. Watts, the estimated cost has advanced to a total of 1,138,606*l.* The number of ships of this formidable type must be limited.

It is essential that the Admiralty should have at their disposal auxiliaries for scouting duties. Ships of exceptional speed are necessarily costly, and the return to the shipowners is doubtful. The fast and powerful liners under the German flag belong to fleets far exceeding in numbers and tonnage those under the British flag. The Cunard Company's fleet consists of ten ships only, of which four are the well-known *Campania, Lucania, Etruria,* and *Umbria.* The Hamburg-American Company, to which the *Fürst Bismarck* and *Deutschland* belong, are the owners of no less than thirty-two ships, of which two only can be described as small vessels. The Norddeutscher Lloyd, owners of the *Kaiser Wilhelm II., Kronprinz Wilhelm, Kaiser Wilhelm der Grosse,* and *Grosser Kurfürst* has a fleet of seventy-two ships, of which five only are small vessels. These German companies have powerful resources. It may be for their advantage to run some ships at a loss, with a view to give a name to the entire fleet under their flag. This, therefore, is a point of consideration whenever we come to deal in a practical way with the requirements of the British Navy in regard to mercantile auxiliaries.

It is desired in the present paper to urge a more liberal expenditure on subsidies to fast ocean services, and thus to provide the fleet, at the lowest cost, with a reserve of ships for scouting duties. Such ships may serve another purpose. Practical instruction in engine-room and stokehold duties for newly-entered men in the Royal Navy was formerly obtained in the transport service. It may be given, and at less cost, in the auxiliary vessels of the Navy.

We have already established mail services to the Cape, to the East, and to Australasia. We may improve those services. The ships may be capable of higher speeds. They may be fitted with portable armor, and with bulkheads for more minute internal subdivision when employed as scouts. We may establish new lines, such as those so much desired in Canada, to connect the Dominion with Australia and the United Kingdom; and while fostering trade, providing scouts for the fleet, and increasing the means of training for the engine room complements of the Navy, and more especially for men on whom we may rely as reservists, we may do something effective in a cause which we all have at heart. Swift communications are a bond of empire. The establishment of a fast service between the nearest British port and Halifax was recommended to the Select Committee on Steamship Subsidies by Senator Drummond, of Montreal, on the ground that he considered a fast line of communication of imperial importance.

Addressing the Institution of Naval Architects, I may once more ask these questions: Is it possible to build ocean liners, able to carry portable armor, and fitted for additional internal bulkheads, without increasing the cost unduly, or impairing efficiency for peace service? Is it feasible to look for reduction in the cost of cruisers, specially designed as vessels of war?

DISCUSSION.*

Professor Biles was the first speaker. He pointed out that the paper was a natural sequel to that read by the author in Glasgow, which resulted in the formation of an Admiralty Committee to consider the question of mercantile auxiliaries. The speaker was appointed a member of that Committee, the reference for which was confined to high speed vessels, and an attempt was made to relate speed to subsidy. He had put a rider to the report, and considered that the Committee had not interpreted the reference as widely as might have been done; other vessels, having speeds short of the highest, such as 16 to 20 knots, might, he thought, have been taken into consideration. He assumed that Lord Grassey had such vessels in his mind when he said that the fast line of communication was of imperial importance; that, the speaker thought, was the key to the situation. The other view was that vessels which could maintain communication on our ocean routes would be able to act as scouts. The question arose as to what constituted a scout. Any vessel built for the Navy at present as a scout might be taken as useless for mercantile purposes; but it by no means followed that ships built for mercantile uses would be unserviceable as scouts. In 1894 he had read a paper at Southampton, in which he endeavored to show that vessels which would be useful for earning money could be so built as to be of service in warfare. He had there indicated a system by which protection could be put on to mercantile ships for warlike purposes. [(See *Engineering*, vol. lviii., pages 402.) It will be remembered that Professor Biles proposed constructing the sides of vessels with recesses which could be filled with wood in time of peace, but would take armor plates when needed for warlike purposes, coal bunkers being placed at the sides for increase of protection.] He

* This discussion is taken from *Engineering*, London, April 1, 1904.

would point out that if vessels of the very highest speed were needed, it would not be possible to carry portable armor; ships of this nature were not used for cargo purposes, the whole displacement being required for the speed, and so there would be no margin for the additional weight of armor. It would not be difficult, however, to translate ships of 18 to 20 knots, which carried cargo, into armored cruisers. Lord Brassey had addressed to members of the Institution two questions: "Is it possible to build ocean liners able to carry portable armor, and fitted with additional bulkheads, without increasing the cost unduly, or impairing efficiency for peace service? Is it possible to look for reduction in the cost of cruisers specially designed as vessels of war?" The problem of cost had been referred to in his paper. He would answer Lord Brassey by saying that what he asked was possible, and he thought that subsidies to meet the case on the lines which were referred to were desirable. The Government would be quite justified in paying such subsidies, in view of the advantages to be obtained.

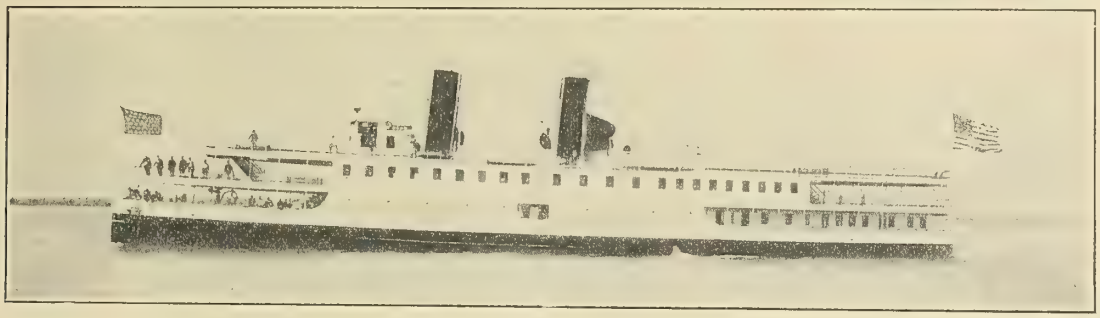
Admiral Sir Digby Morant pointed out that probably in war time most of the ships that were now subsidized would be required to keep open the communications with foreign countries, and, therefore, they would not be available for scouts. These fast liners only carried coal for about six days at their highest speed, and there was no part of the displacement devoted to cargo which could give place to coal. He thought there would be very great difficulties in making a ship, fit for ordinary mercantile duties, suitable for portable armor. Some years ago he was ordered to fit out certain merchant ships for naval purposes. He provided protection by an arrangement of the coal bunkers, but in those times there were not in existence the fast cruisers we now have. That defect had been remedied, and we now had warships that were capable of very high speeds, and special scouts were being built. Under these circumstances he doubted whether any advantage would be obtained by taking mercantile vessels as additional cruisers for the fleet. For war purposes no ship without protective armor could live through a fight.

Admiral Fitzgerald was also one of the members of the Committee which had sprung out of Lord Brassey's paper, and his opinion was that ships fit for scouting purposes would not be suitable for mercantile work; it would be far better to build ships specially for the purpose. It is true Lord Charles Beresford had said that no ship would form a better scout than an ocean grayhound, but at that time the fast ships we now have did not exist. There seemed to be some misapprehension as to what were scouting duties, and he would point out that it was only necessary for these vessels to go out and bring back news to the fleet, having sufficient armament to fight destroyers, or other ships smaller and faster than themselves. He considered the second-class cruisers of no use. He did not believe that the system of having portable armor was one that could be relied upon, as it would take a long time to put on the plates. The armor would be kept on shore, and at the outbreak of war it might not be near the ship for which it was intended. The introduction of wireless telegraphy had rendered it less necessary that there should be a large number of scouts, and it would be noticed that in Far Eastern waters the Japanese were working without scouts. On the whole, he thought it would be better to spend money on building cruisers than on subsidizing merchant vessels.

Admiral Sir Edward Freemantle did not entirely agree with some of his brother officers, but was inclined to take the side of Lord Charles Beresford. He considered no other ship so good as an ocean grayhound for scouting purposes. If Admiral Fitzgerald could get one of the scouts across the Atlantic and back again at full speed, then it might not be necessary to have recourse to these fast liners; but he thought that could hardly be done. Supposing the fleet were in the West Indies when war was declared, would it be possible for it to get back at 18 knots the whole way? Those who thought such a thing possible would do well to look at the report of the last manœuvers. The gallant admiral did not appear to think favorably of the armored cruisers. He pointed out that some years ago we were not building any, but now we appeared to have got them on the brain. He agreed with Lord Charles Beresford that if he were in command in the Atlantic, and wanted to send to the West Indies, he would have grave doubt if a cruiser could make the voyage satisfactorily; but if he had such a vessel as the *Campania,* he would have confidence that she would make the voyage at 21 knots. The man-of-war could not keep up the speed attained on the measured mile within 3 or 4 knots for a 1,000 miles' run. He would therefore have ocean liners as long-distance scouts. He was not in favor, however, of arranging vessels for taking the armor in the way suggested by Professor Biles; these portable arrangements did not work well. He remembered one case—that of the *Shannan*—in which the vessel had an adjustable ram which could be shipped or unshipped in times of peace or war.

Professor Biles, referring to what had been said by the last speaker, thought that the discussion should not close without it being pointed out that vessels of the length of scouts should not be expected to cross the Atlantic at 20 knots. The *Deutschland* was 680 feet long, and made a speed of 23 1-3 knots. It would be necessary to have a vessel at least 500 feet long to make 20 knots continuously at sea.

Lord Brassey, in replying to the discussion, said that the position of this country was perfectly plain. We had reached a scale of expenditure for the Navy which was enormous. The last estimates gave a total of not far from 37 million sterling, of which over 18 millions were in the shipbuilding vote. Yet it was not possible to cut down the expenditure on battleships, and the money devoted to armored cruisers was not excessive. It yet remained that we wanted more scouts. Admiral Fitzgerald said: "Build more of these vessels;" but that would mean an increase of expenditure which it was difficult to contemplate. We were all ready to vote large appropriations, but there was a limit to the possibility of taxation, and that was the reason he had offered a suggestion to make use of auxiliary vessels in war time.



STEAMBOAT PENN OF THE BALTIMORE & PHILADELPHIA STEAMBOAT COMPANY.

STEAMERS OF BALTIMORE AND PHILADELPHIA STEAMBOAT COMPANY.

With the opening of the summer excursion season, the steamers *Penn* and *Lord Baltimore* will be placed on the Baltimore-Philadelphia service of the Ericcson Line. These two fast vessels were built at the Harlan & Hollingsworth Company, Wilmington, Del., and were brought out for this line in the summer of 1903. The route from Philadelphia to Baltimore is first down the Delaware river as far as Delaware City, and thence through the Chesapeake and Delaware canal to the Elk river at the head of Chesapeake bay. It is an interesting route throughout, especially through the canal which has to be entered and left through locks. The new boats make the trip by daylight.

MARINE ENGINEERING DATA CARD. **MAY, 1904.**

NAMES—Penn and Lord, Baltimore.
LAUNCHED—1903.
NATIONALITY—American.
BUILDERS—Harlan and Hollingsworth.
TYPE—Passenger steamer.
OWNERS—Ericcson Line.

Length over all.....203 ft. 0 ins.
" between perps.....190 " 0 "
Beam, molded.....23 " 5 "
Depth, " .....12 " 0 "
Tonnage, net.....288
Draft, load.....for'd, 8 ft. 0 ins. aft, 9 ft. 4 ins.
" light.....5 " 6 " 8 " 4 "
Displacement load, in tons, 9 ft. mean draft, 615 short tons
Engines: Number.....1
Type.....4-cylinder, triple
Cylinder diameters.....21, 32, 35 and 35 ins.
Stroke.....24 "
Valves, 1, piston on H. P. 12 1-2 ins. diam.; 2, piston on I. P. 12 1-2 ins. diam.; slide on L. P.
Shafting, crank, thrust, diam., 9 1-4 ins.
Line.....9 1-8 "
Shafting, propeller.....9 1-2 ins.
Collars on thrust.....10
" diameter.....16 1-4 ins.
Propellers, diameter.....8 ft. 0 ins.
Propeller: Pitch.....10 " 6 "
Diameter.....8 " 0 "
Area, developed, 42 per cent. of disk, 21 " 0 "
Blades, number and material, 4, manganese bronze
Framing.....Cast iron inverted Y-back, open front, steel stanchions
Boilers:.....4 Almy water tube
H. S., total.....6,879.2 sq. ft.
G. S.....199.32 " "
Pressure.....200 lbs.
I. H. P., in service.....2,000
Rev., " " 200
Speed, " " ...20 miles per hour

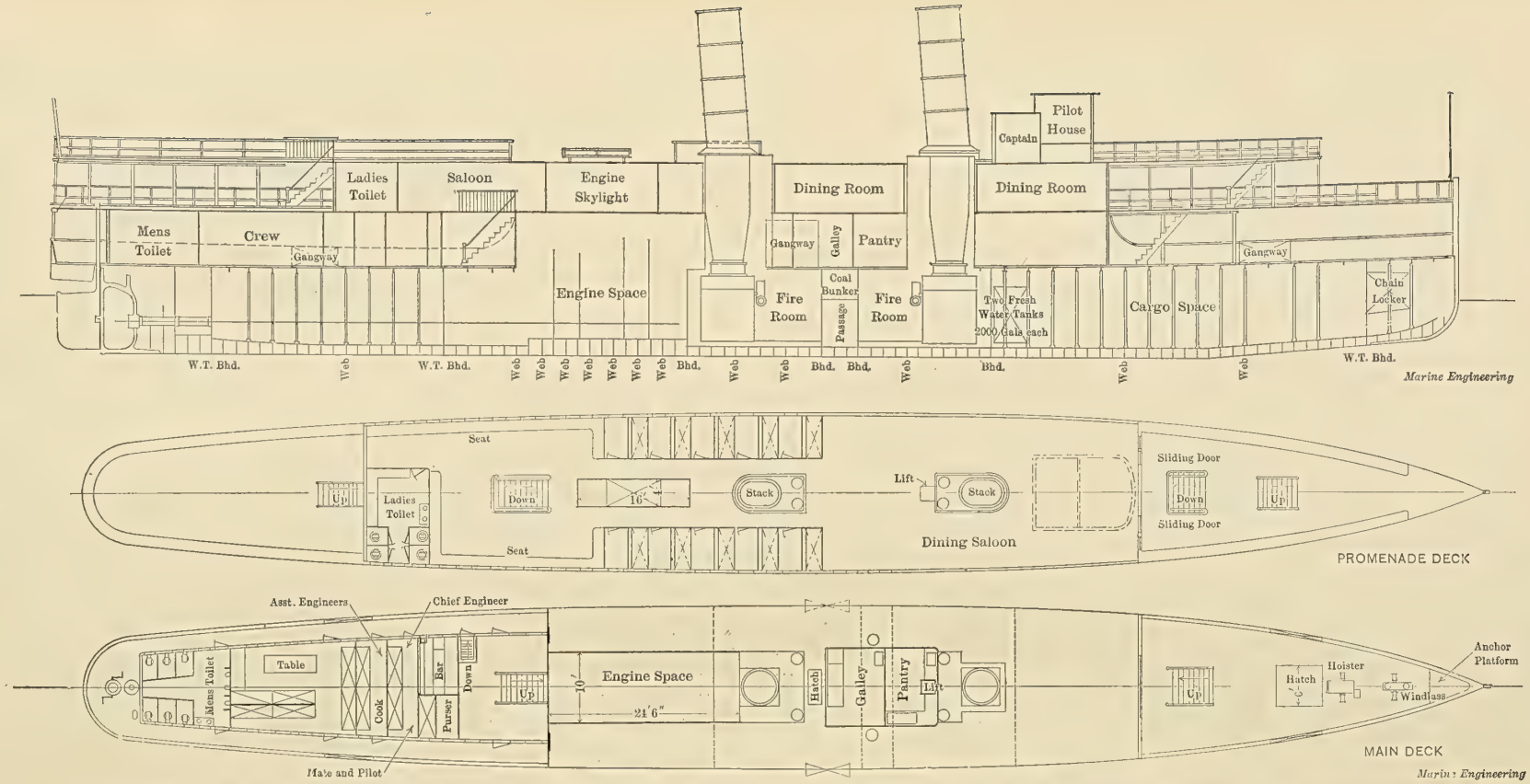
The general dimensions of the vessels are: Length over all, 203 feet; beam, molded, 23 feet 5 inches; draft, 9 feet; speed, 20 statute miles. Other details will be found in the data card. The two vessels are built of steel and are identical in every particular; the construction is shown on the midship section diagram on page 235. There are four water tight bulkheads up to the main deck. On the main deck forward is an open space for handling lines and what little freight is carried is placed here and in the forward hold. The boats are distinctly passenger vessels. A Williamson hoisting engine is placed forward and there are also two cranes for handling light cargo from the lower hold.

Midships the side of the hull is steel plated between the main and upper decks, for stiffness and for the prevention of fire. Steel casings are carried up to the upper deck around the engine and boiler room inclosures. On the main deck aft are the purser's quarters, men's smoking room and toilet accommodations for the officers and part of the crew, the latter being under the after end of the saloon deck. The galley and pantry are on this deck forward of the aft smoke stack, and are well equipped. The plumbing throughout the boat is of the latest sanitary pattern, and there is an abundant water supply.

The dining saloon is at the forward end of the house on the upper deck. It is well lighted from skylight above and with windows at sides and at forward end. On each side of the house are five large comfortable state rooms for the convenience of invalids and those desiring privacy. The dining room has accommodation for seating 76 people at one time, and the food is brought up from the pantry below through an elevator shaft. At the after end of the house is a comfortable saloon with a cozy corner and seats for a number of passengers. A large deck space is provided on this deck both forward and aft of this house, seats being fitted around the rail. In all 786 passengers are allowed to be carried according to certificate.

The hurricane deck is carried from well forward to the stern and presents an almost unbroken promenade for the passengers. The pilot house and captain and mates quarters are just forward of the funnel. A steam steering gear of the Williamson pattern is provided for rapidly handling the vessel, while for emergency hand gear may be used.

Large power has been put into each of these light draft boats, consisting of one four-cylinder triple expansion engine developing about 2,000 I. H. P., driving

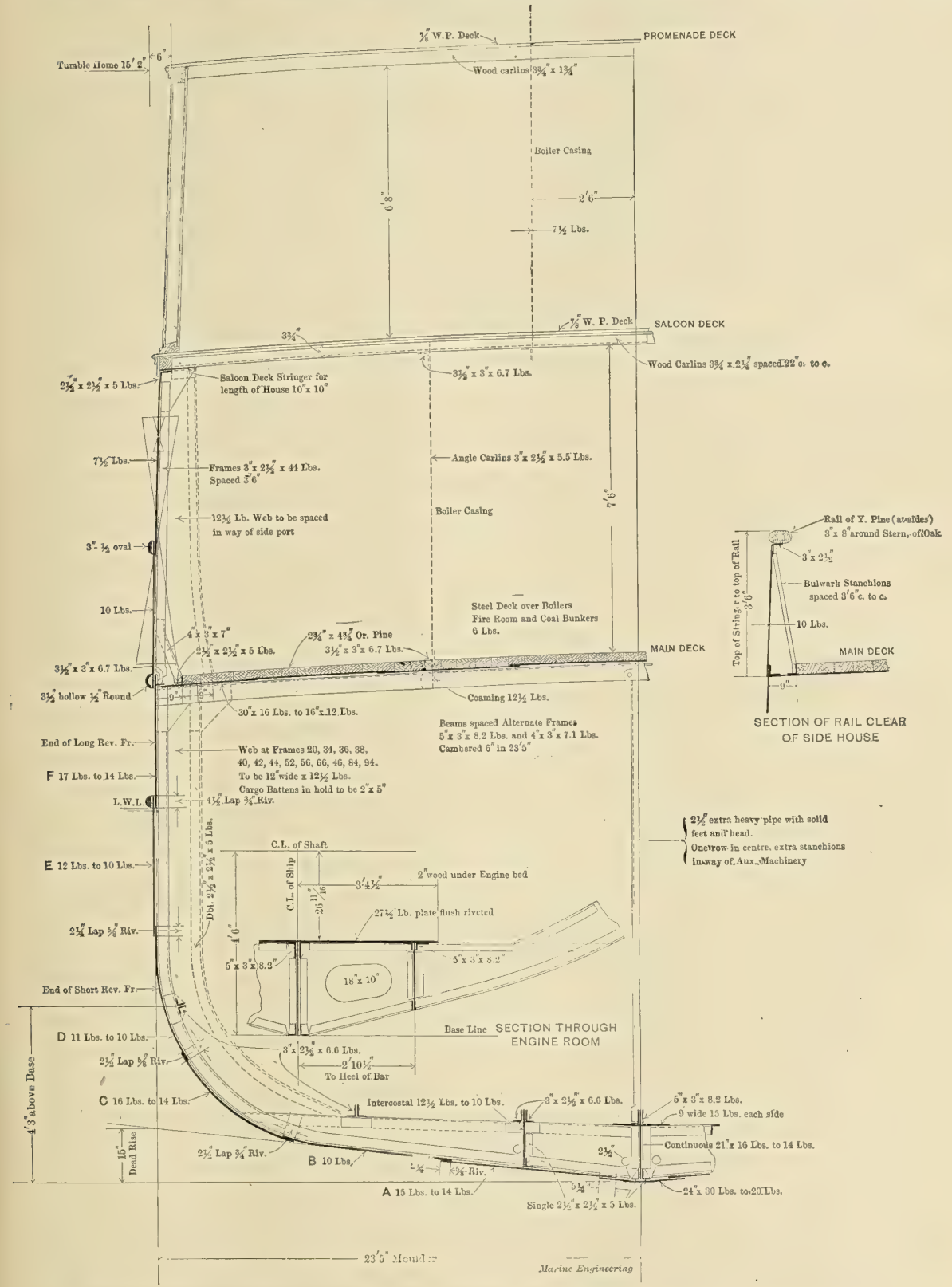


ELEVATION AND DECK PLANS OF THE STEAMBOATS PENN AND LORD BALTIMORE, RUNNING ON THE INLAND ROUTE BETWEEN PHILADELPHIA AND BALTIMORE.

the vessel at a speed of 19 miles an hour. The engine has cylinders of the following diameters: High-pressure, 21 inches; intermediate, 32 inches; two low-pressures, 35 inches each; the common stroke is 24 inches. One piston valve, 12 1-8 inches diameter is fitted on the high-pressure cylinder; two piston rods, each of 12 1-2 inches diameter are fitted on the intermediate, and a balanced slide valve on the low-pressure. The cylinders are mounted on the iron inverted Y box section framing at the back, and steel stanchions on the forward side. The engines are designed for fast running with as little vibration as possible, owing to the light construction of the hull. The arrangement of the cranks is, high-pressure opposite forward low-pressure, and the intermediate opposite the after low-pressure, with both pairs of cranks at right angles.

All pumps are independent of the main engines, as well as the condenser, which contains 3,000 square feet of cooling surface. The air pump is of the twin cylinder, vertical type, made by Davidson, who is the maker of the vertical feed pump. Blake tank, bilge, and sanitary pumps are installed. The crank shaft is a solid forging 9 1-4 inches diameter, while the line shaft is reduced to 9 1-8 inches and the propeller shaft increased to 9 1-2 inches. There are ten collars fitted on the thrust shaft, which is 9 1-4 inches diameter, the collars being 16 1-4 inches. The propeller has four blades, manganese bronze, is true-screw, 8 feet in diameter, with developed area of 21 square feet.

Steam is supplied by four Almy water tube boilers, placed in two stoke holds, each set of boilers leading to a separate funnel. The working steam pressure is 200 pounds, the grate surface 199.32 square feet, and the heating surface 6,879.2 square feet. For increasing combustion Bloomsburg steam jets are placed in the stacks.


PROMENADE DECK
SALOON DECK
MAIN DECK
Boiler Casing
Steel Deck over Boilers Fire Room and Coal Bunkers 6 Lbs.
Coaming 12½ Lbs.
Beams spaced Alternate Frames 5"x 3"x 8.2 Lbs. and 4"x 3"x 7.1 Lbs. Cambered 6" in 23'5"
Web at Frames 20, 34, 36, 38, 40, 42, 44, 52, 56, 66, 46, 84, 94. To be 12"wide x 12½ Lbs.
Cargo Battens in hold to be 2"x 5"
Saloon Deck Stringer for length of House 10"x 10"
Frames 3"x 2½" x 44 Lbs. Spaced 3'6"
12½ Lb. Web to be spaced in way of side port
Angle Carlins 3"x 2½" x 5.5 Lbs.
Wood Carlins 3¾ x 2¼" spaced 22" c. to c.
Wood carlins 3¾" x 1¾"
3½" x 3" x 6.7 Lbs.
2¾" x 4¾" Or. Pine 3½" x 3"x 6.7 Lbs.
2½" x 2½" x 5 Lbs.
4" x 3" x 7"
30"x 16 Lbs. to 16"x 12 Lbs.
3½" hollow ½" Round
3" ½ oval
10 Lbs.
7½ Lbs.
Tumble Home 15' 2"
6"
6'8"
2'6"
7½ Lbs.
7'6"
3¾"
7/8" W. P. Deck
L.W.L.
4½" Lap ¾" Riv.
End of Long Rev. Fr.
End of Short Rev. Fr.
F 17 Lbs. to 14 Lbs.
E 12 Lbs. to 10 Lbs.
D 11 Lbs. to 10 Lbs.
C 16 Lbs. to 14 Lbs.
B 10 Lbs.
A 15 Lbs. to 14 Lbs.
2¼" Lap ⅝" Riv.
2½" Lap ⅝" Riv.
2½" Lap ¾" Riv.
Dbl. 2½" x 2½" x 5 Lbs.
C.L. of Shaft
C.L. of Ship
3'4½"
2" wood under Engine bed
27½ Lb. plate flush riveted
5"x 3"x 8.2"
18"x 10"
SECTION THROUGH ENGINE ROOM
Base Line
3"x 2½" x 6.6 Lbs.
2'10½"
To Heel of Bar
Intercostal 12½ Lbs. to 10 Lbs.
3"x 2½" x 6.6 Lbs.
5"x 3"x 8.2 Lbs.
9 wide 15 Lbs. each side
Continuous 21"x 16 Lbs. to 14 Lbs.
24"x 30 Lbs. to 20 Lbs.
Single 2½"x 2½" x 5 Lbs.
4'3" above Base
15" Dead Rise
23'5" Moulded
Marine Engineering
2½" extra heavy pipe with solid feet and head. One row in centre, extra stanchions in way of Aux. Machinery
Rail of Y. Pine (at sides) 3"x 8" around Stern, of Oak
3"x 2½"
Bulwark Stanchions spaced 3'6" c. to c.
Top of Stringer to top of Rail 3'0"
10 Lbs.
MAIN DECK
9"
SECTION OF RAIL CLEAR OF SIDE HOUSE

MIDSHIP SECTION OF STEAMBOATS PENN AND LORD BALTIMORE, BUILT BY THE HARLAN & HOLLINGSWORTH COMPANY.

On a trial course 1 statute mile in length it was stated that the engines ran at 230 revolutions, developed 2,250 I. H. P. and drove the vessel at a speed of 25 statute miles.

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NOW that it is claimed by many steam engineers, that the highest point of economy with the present materials of construction has been reached with the steam engine through multiple expansion, the recent investigations concerning superheated steam and the results obtained of steam plants where superheat is used, are of special importance. Several years ago, when boiler pressures of from 20 to 50 pounds were ordinary, many types of superheater were patented and built in this country and abroad, and the records of tests show that in almost every case decided economy resulted. With the introduction of the compound and triple expansion engine, higher steam pressure, and earlier cut-offs, these superheaters were laid aside, doubtless because of the many difficulties met with by the engineers of those days in handling the increased temperature, and all of the attention was devoted to improving the economy through increasing the ratio of expansion. Several superheaters were installed on American vessels, some designed by the famous Isherwood, but all these have disappeared with the exception of the steam drum built around the smoke stack in several paddle wheel and small boats.

To-day there are running in Europe many large plants fitted with superheaters. Tests have been made which clearly demonstrate that the gain for the superheater is practical as well as theoretical. The American engineer is now following his foreign brother in adopting the superheater.

The advantages of superheat, as laid down by Rankin, are threefold, *viz.*: to raise the temperature at which the fluid receives heat and so increase its efficiency without producing a dangerous pressure; to diminish the density of the steam and so lessen the back pressure; finally, to prevent the condensation of the steam during its expansion, without the aid of a jacket. Instead of carrying a high pressure with saturated steam, the same amount of heat may be carried to the engine, and more efficiently at a lower pressure, with steam superheated. The advantage of a lower pressure and resulting lessened weights of both engine and boiler are apparent to all. The other actual gain in superheating steam results from decidedly reducing the loss by cylinder condensation. With saturated steam no transfer of heat, however small, can take place from the steam to the cylinder without the condensation of some steam and the depositing of it on the wall of the cylinder. Also the wet cylinder wall forms a good conducting medium for the radiation of latent heat from the saturated steam, causing increased condensation. Upon exhaust this steam is re-evaporated at the lower exhaust pressure by the heat in the walls of the cylinder. With superheat, part of the heat may be transferred to the walls without causing condensation, and being comparatively non-conducting, if dry at release, will receive very little heat from the cylinder walls; thus, it may be assumed that a higher mean temperature is secured to the cylinder walls. Experiments have fully demonstrated this decreased condensation with superheat. Therefore, that amount of heat radiated to the cylinder walls should be added to the steam before it enters the engine, in order to prevent cylinder condensation. Assuming this loss to be 20 per cent. of the latent heat, Regnault determines 520 degrees to be roughly the proper amount of superheat for ordinary pressures.

On the pages of this magazine will be found a description of a superheater which, in another form, has been installed for several years on

board ship, and in the present form has given conclusive proof of the great advantage to be derived from superheated steam. Two types of superheaters are built. First, that in which a separate fire is used, giving independent control of the degree of superheat; second, that in which the fire under the boiler is used for supplying the heat. This last may be subdivided again into one class where no regulation of the heat is possible, and a second class where regulation of the heat is independent of the fire under the boiler. It is to this last class that the superheater here illustrated belongs.

On board ship, where the coal economy is of prime importance, and every pound saved means so much more cargo space available, the steam superheater should find its place. Naturally the engineer is loath to see another auxiliary installed which will not only take more labor to look after but will involve another uncertain element in the steam line, subject to breakdown. However, with superheaters given ordinary care and attention, no trouble whatever has been experienced, and the amount of repairs has been practically *nil*. The economy of the steam turbine is most decidedly improved with superheated steam, even to a larger extent than with reciprocating machinery.

Believing this matter to be of great importance to the marine engineer, we commend this subject to our readers and will be pleased to receive their communications and data relating thereto.

AFTER many conflicting reports the directors of the Cunard Company have determined to fit their two new transatlantic express steamers with steam turbines. This decision has been reached after extensive investigation by a commission made up of the most prominent engineers and naval architects in the country. Comparative tests were conducted on two ships of the New Haven-Dieppe route, the ships being practically the same, only that one was fitted with reciprocating engines and the other with turbines. The commission has also exhaustively investigated different types of steam turbines and steam turbines plants on shore. The full report has not yet been made public, but it is understood that the power of the ships is to be divided on four shafts, the two outboard ones being fitted with high-pressure turbines, and the inside pair with low-pressure machines and also with the reversing turbines. Each shaft will have one propeller, as results, both in England and in France, have demonstrated that the efficiency is greater with one propeller of fine pitch running at a slip of not over 25 per cent. than when more than one are used on the same shaft. As a result of extensive model experiments it is understood that with a length of 760 feet, a beam of about 88 feet will be required to carry the enormous weight of machinery, and for driving the ships at 25 knots, the estimated indicated horse power will be not less than 70,000. While it is proposed to run the ships at an average speed of 24.5 knots for the entire voyage, the designs call for an extra half knot to allow for making up time due to delays of any cause.

This decision, arrived at after such extensive experiments and investigations is, indeed, an important one in marine engineering. The claims of the turbine builders for great reduction in weight and increased economy have, it is understood, not been substantiated by the commission's investigations, as it is stated that the saving in weight over reciprocating engines will be but 3 per cent., and the economy demonstrated on the channel steamer tests is only about 2 per cent., which is, indeed, disappointing. Results of steam turbine plants on shore, which have been in operation for a number of years, show much better economy than this. At present the vessels equipped with steam turbines include those running on routes across the English and Irish channels and a few yachts. Many ships under construction are to be fitted with turbines to ply along the British coast, in the Australian and New Zealand trade and on the Great Lakes, but the largest order was for the two Allan liners of 10,000 tons and 17 knots speed. With these vessels completed, abundant data will be attainable for a definite opinion as to the exact merits of the marine steam turbine.

WE have for some time realized that there has been a demand by shipbuilders and owners for a responsible agency where they might learn of experienced and competent men to fill vacancies from head of departments down to engineer or machinist. Therefore, we have undertaken, as elsewhere stated on these pages, such an exchange for the purpose of looking up the records of all men who apply and recommending only those who, in our opinion, can fill the requirements of the vacant position.

Launch of the United States Battleship Virginia.

BY H. H. BYRNE.

Another battleship has been added to our Navy. Amidst the usual ceremonies attending the launching of a war vessel, the *Virginia* was, on April 5, successfully launched at the Newport News Shipbuilding and Dry Dock Company's yard, Newport News, Va.

The general dimensions of the *Virginia* are:

Length on water line	435 ft. 0 in.
Breadth	76 " 2½ "
Draft, mean, at trial displacement,	23 " 9 "
Displacement on trial	14,948 tons.

As recent as 1898, when our navy had but four battleships, *viz.*, the *Oregon, Iowa, Indiana* and *Massachusetts,* the line of demarcation between them and the cruisers of their time was very sharply drawn. A comparison of the *Brooklyn* and *Oregon* will show how evident this is; the former is a cruiser of 9,215 tons, or 1,027 tons lighter than the battleship; has a greater horse power by 7,658 than the *Oregon,* and likewise carries more but smaller guns, 20 in all, or four more than is carried by the battleship. Now note the slight difference between the two new vessels, the battleship *Virginia* and the cruiser *West Virginia.* The former's displacement is about 15,000 and the latter's 13,268 tons. The difference in horse power between the *Virginia* and *West Virginia* is 4,000; while that between the smaller ships, the *Oregon* and *Brooklyn,* is 7,658. The *Virginia* and *West Virginia* have twenty-four and twenty-two guns respectively in their main batteries, the battleship, be it noted, having the advantage by two guns. Now with the *Oregon* and *Brooklyn* it is twenty guns to sixteen guns (main batteries), which is in favor of the cruiser. And in various other ways these former differences have been narrowed, overcome or reversed, until now a battleship is an excellent cruiser and a modern cruiser well compares with a battleship and would be more than a match for one of the *Oregon* type.

The *Virginia* is one of the three battleships provided for by Congress in 1899, which, with the two voted for in the session of 1900, are to compose a fleet known as the coast line battleships. These last two, the *Louisiana* and *Connecticut,* it will be remembered, are being constructed competitively, one by the Government at the New York navy yard and the other by a private firm, which, as it happens, is the same company that built the cruiser *West Virginia,* launched last April.

The *Virginia* will carry four 12-inch guns, mounted in pairs within turrets in their usual position, one forward and the other aft. Of the eight 8-inch guns four will be superposed in turrets on the turrets for the 12-inch guns; the other four will be housed in two separate turrets on either side of the vessel slightly forward of amidship. The 12-inch turret guns and likewise those superposed will have a sweep of three-quarters of a circle, those amidship will have a radius of one-half circle, thus enabling them to fire directly ahead or astern. The smallest gun of her main battery will be twelve 6-inch, equally divided on the vessel's broadsides; two being forward and four aft of the amidship turrets. These guns will be capable of firing at an object within an arc of 121 degrees.

The secondary battery will consist of twelve 3-inch rapid fire guns; twelve 3-pounder semi-automatic; eight 1-pounder heavy automatic; two .30-caliber machine guns, and six .30-calibre Colt automatic guns, all mounted in commanding positions and having large areas of fire, and two 3-inch field guns. The *Virginia* will also be fitted with submerged torpedo tubes.

The magazines have been exceptionally well fitted and provide room enough to stow away sixty rounds for each of the four largest guns; 125 rounds for every 8-inch; 200 rounds for every 6-inch and 300 rounds for each of the 3-inch guns and an almost unlimited supply of shell for the smaller guns.

The *Virginia* has a belt of armor 8 feet in width amidships that is 11 inches thick at the top and 8 inches at the bottom, this belt gradually tapers until it is 4 inches thick at both ends of the vessel. Extending from the top of this belt to the upper deck there is another belt of 6 inches thickness that extends from the forward to the after turret. Within this wall or casemate the broadsides or six-inches guns will be mounted, each one separated from the others by a steel splinter bulkhead. That part of the main turrets on the outside of the casemate will be protected by barbettes 10 inches thick, which will likewise shield the portion of the turret not in view, but the armor in this case will taper to 7 1-2 inches. The large turret walls are 12 inches in thickness, while the turrets for the 8-inch guns are to be protected by 6-inch armor, and have barbette protection similar to the other turrets. The conning tower and its shield will be 9 inches in thickness and an armored casing 5 inches thick will be large enough to protect all the speaking tubes, signalling wires, etc. The after conning tower is protected with 5-inch armor. To reduce to a minimum the effect that any shell would have if it did penetrate the armor and at the same time to doubly insure the ship's boilers and engines, there is a protective deck of nickel-steel 1 1-2 inches thick on the flat and 3 inches on the slopes. Just above this deck and for the entire length of the ship on both sides there will be a cofferdam belt three feet thick and packed eight pounds to the cubic foot.

The machinery will consist of two sets of four-cylinder triple-expansion engines, which are to develop 19,000 indicated horse power to drive the ship at 18 knots on trial. The engines have cylinders 35, 57, 66, and 66 inches diameter, by 48 inches stroke. Twenty-four water tube boilers of the Niclausse type will furnish the steam. The total grate surface will be approximately 1,280 square feet, and the total heating surface, 57,534 square feet. The normal coal bunker capacity is 900 tons, giving a steam radius at ten knots of about 3,500 nautical miles. The total bunker capacity, including reserve bunkers, is 1,700 tons.

When ready for sea the *Virginia* will carry 44 officers and a crew of 768 men, including marines, and if need be she can be used as a flagship, for she has ample accommodations for an Admiral and his staff.

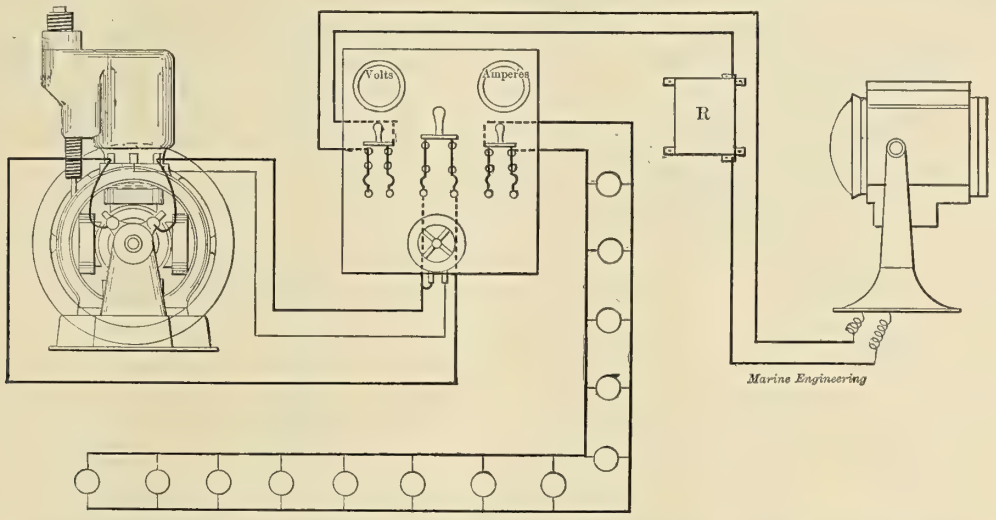
Like in all ships built nowadays electricity is one of her most important factors. The ammunition hoists, turret, operating machinery, aside of the ship's locomotion, capstan and steering gear, are to be operated by electricity. For these purposes she is to have eight engines and dynamos.

ENGINEERING SPECIALTIES.

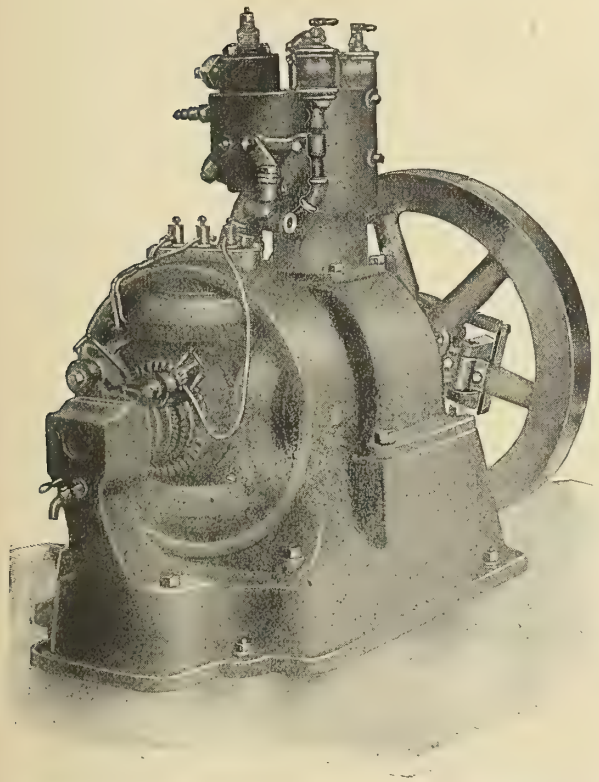
Small Gasoline Engine-Driven Generator.

For those owners who do not care to use a storage battery in their electric lighting outfit, there are two alternate equipments; the first for larger boats of any description (power or sail) consists of a generator direct connected to a small gas engine; the second, the smaller class of motor boats is simply a generator driven by belt from the flywheel of the propelling engine and properly connected up.

A type of the first outfit is illustrated on this page and consists of a generator direct connected to a 2 1-2 H. P. gasoline 4-cycle single-cylinder engine. The speed of the dynamo is 750 revolutions per minute. The armature is compound wound and mounted on a sleeve which slips over the crank shaft and is held securely in place by means of a long key. The governor is contained in the flywheel and gives close regulation varying only 2 per cent. from no load to full load. The floor space occupied is 20 to 34 inches, the height over all is 30 inches and the weight complete is but 475 pounds. The switchboard has mounted upon it the field regulator rheostat, a main switch and two smaller switches, one on each side, one controlling a circuit for the incandescent lamps and the other the searchlight circuit. On the upper part of the board are placed an ammeter and voltmeter. The connections are not shown on the back of the board for simplicity's sake, but the circuit may be easily traced out from the plan. At *R* is the searchlight resistance, which is connected in series with the searchlight and to be placed anywhere out of the way, where the heat produced will not cause injury. Of course, if the searchlight is not desired more incandescent lights may be installed and the number of circuits increased. In this plan simplicity has been aimed at and as few switches, cut-offs, etc., as possible have been used. This generating set and searchlight are manufactured by the Carlisle & Finch Co., 234 E. Clifton ave., Cincinnati, O.



WIRING PLAN OF CABIN- AND SEARCHLIGHTS, GENERATOR DIRECT CONNECTED TO 2 1-2-H. P. GASOLINE MOTOR.



GENERATOR DIRECT CONNECTED TO 2 1-2-H. P. GASOLINE ENGINE.

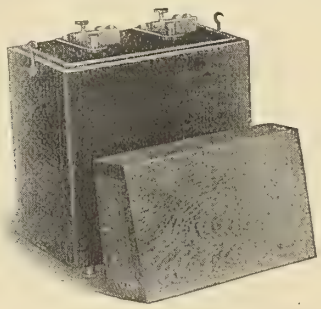
Induction Coil for Igniter.

That form of device for igniting the charge of gasoline and air in gas engines which is now generally considered the best, is the jump spark system. It is more economical in battery and it provides more rapid and complete combustion of the gases, owing to the greater heat produced at the spark points.

Its use eliminates all working parts within the cylinder, thus doing away with a constant source of annoyance. It will ignite gases having greater variation in quality than will any other form of ignition, thereby

providing a greater range of usefulness for the engine. It is noiseless, has no rods, hammers, working joints, etc., to wear out, and in addition can be applied at smaller cost, except, perhaps, on the small sizes of cheap stationary engines.

The Mueller coil here illustrated can be relied upon to ignite the charges even where the engine works with highest compression. A poor coil is liable to miss sparking under these conditions, for as compression increases so does the resistance to the passage of the electrical current across the spark points. These coils



DOUBLE DASH INDUCTION COIL FOR IGNITING OUTFIT.

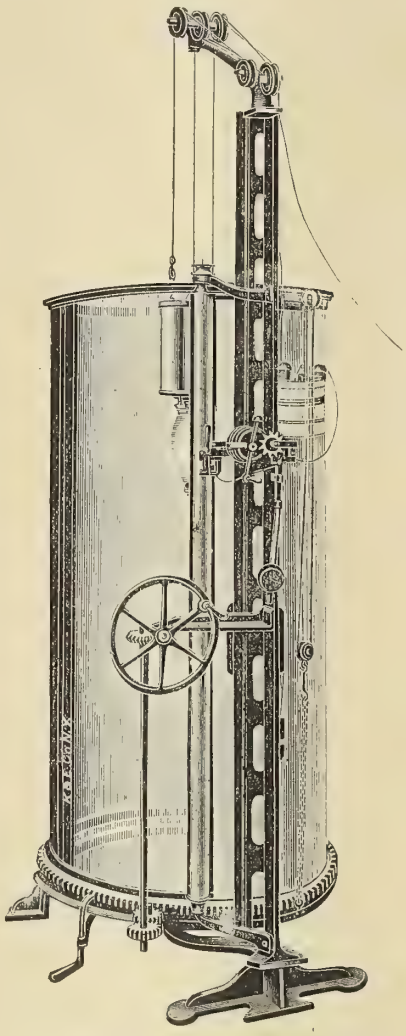
are the result of many years of practical experience in such class of work, and are of the very best type; insulation is of the heaviest. A distinctive feature of the Mueller coils is a safety gap, so set and gauged that should the plug wires ever become detached through accident or otherwise the coil cannot readily be damaged, as the spark will jump from one secondary terminal to the safety plug. Thus the possibility of the coil being short circuited is practically nil, and renders the motor more reliable when in the hands of an inexperienced operator. When the spark points are used up, a new vibrator spring with an iridium-platinum point may be furnished, for these parts are interchangeable.

The Induction Coil Company, 9 Miller Building, Milwaukee, Wis., make these coils in a variety of forms for different services.

Cylindrical Electrical Printing Frame.

Sunlight is such an uncertain quantity to depend upon where many and large blue prints are required that most manufacturing concerns now are using the printing frames adapted to print by electric light. The one herewith illustrated is made by the Keuffel & Esser Company, 127 Fulton street, New York, N. Y. It is formed of a vertical cylinder and consists of two sections of curved glass mounted in a metal casing and together forming a cylinder which rotates on a circular base. It requires a floor space of about 36 by 42 inches. The lamp is suspended in the axial line of the cylinder, where it travels by clockwork with electric motive force.

Tracing and paper are placed on the outer surface of the glass cylinder, where they are held by a canvas curtain mounted on a vertical roller attached to the upright which carries also the lamp and the mechanism for moving it. This curtain is wound on the cylinder by rotating the cylinder on its base, which is done by a conveniently placed handwheel. It is held tense by the roller spring and a foot brake on the base plate, which arrests the cylinder. The rotating of the cylinder therefore automatically winds the curtain on to it and holds the tracings and paper in very good contact. The feeding in of the tracing and paper is easily and quickly accomplished, and there is no tilting of the glass cylinder. The unwinding of the curtain is done by means of the handwheel, assisted by the spring acting on the curtain roller.

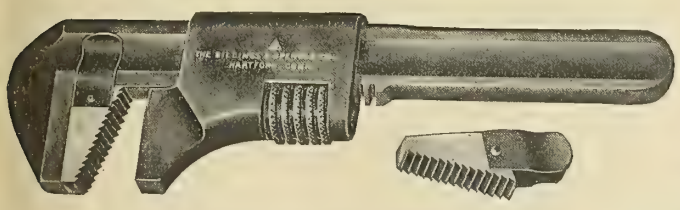


CYLINDRICAL ELECTRIC PRINTING FRAME.

The lamp is of a special pattern to give perfect diffusion and distribution of light. It is moved by clockwork and can be set to any required speed, to any distance of travel, and to start from and stop at any point. The current is cut off automatically at the end of the travel of the lamp. Either direct or alternating current lamps at 110 or 220 volts are furnished with frame. This is an economical apparatus, as it requires only one lamp even for the largest size tracings. The tracings may be inserted and removed quickly and conveniently, as the position of the cylinder does not have to be changed for loading or unloading.

Patent=Adjustable Pocket Wrench.

A combination adjustable wrench with a pipe wrench attachment is, indeed, a handy thing for any engineer or motor launch operator. Such a wrench, made by the Billings & Spencer Company, Hartford, Conn., is here illustrated. The wrench can stand the hardest kind of usage, and is for all purposes for which the monkey wrench is used. It is made throughout of drop forging from steel bar and in two styles, case hardened finish or nickel plated.



POCKET WRENCH WITH PIPE WRENCH ADJUSTMENT.

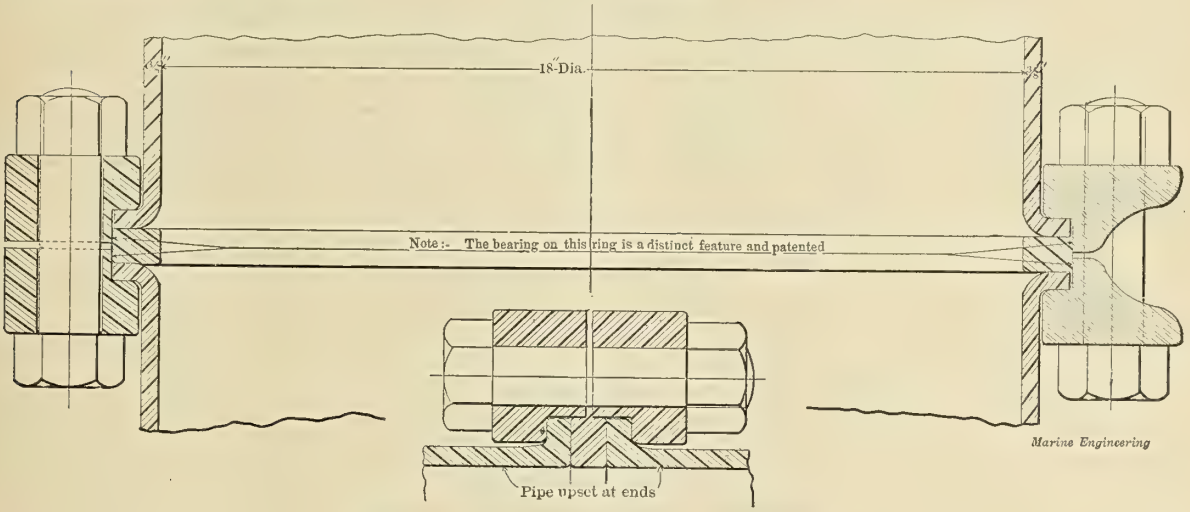
The pipe wrench adjustment consists of a serrated tool-steel jaw with a tempered steel spring, which serves to hold the jaw in place on the wrench. The advantage of this adjustment is that it enables one to instantly convert the adjustable wrench into a pipe wrench, which can be used on pipe up to and including ¾ inch in diameter. The wrenches are made in sizes up to 18 inches, while that shown in the engraving, fitted with the pipe-wrench adjustment, is 8 inches.

hold the pipe flanges in contact with the joint ring. The latter provides a good surface for the flanged ends of the pipe, and also serves on its outer rim as a strut to resist the distortion of the loose flanges due to the tension of the bolts. This fitting of the loose flanges over the joint ring constitutes a special feature of the patent. By this simple device the effective section of the loose flanges becomes equivalent to the combined areas of the flanges and ring.

An internal pressure tending to distend the ring still further adds to its strength against collapse, and sets up a moment which offsets the moment of the bolts tending to distort the loose flanges. Thus, also, the internal pressure automatically increases the tension of the bolts and tightens the joint thereby.

This type of joint allows the loose flanges to be smaller in diameter than any type of fixed flange, as the bolt heads and nuts may be brought close in to the pipe, hence a neater and lighter design is possible, especially for large sizes. For work in close quarters and field work generally this joint is especially suitable. The flanges can be revolved into any position required. The holes are drilled in the shop, and the work is therefore accurate and cheap. Moreover, the joint ring is not put in place till ready to couple up, leaving a still better chance to fit pipes in place or take them down.

The loose flanges may be made of any suitable material, cast or wrought, but the latter is preferable in order to eliminate risk of breakage. The section of the flange will be modified to suit material, as shown in illustration.



FORMS OF PATENT LOOSE FLANGE PIPE CONNECTION.

Patent Loose=Flange Pipe Connection.

One of the greatest problems of engineers ashore and afloat is to get a pipe connection that will be absolutely tight, and yet not involve the use of awkward and expensive flanges. A careful study of the loose flange connection illustrated herewith will show how this problem has been solved by Mr. L. D. Lovekin, chief engineer of the New York Shipbuilding Company.

Special attention is called to the function of the joint ring against which the pipe-ends bear. The ends of the pipes themselves are flanged and form the joint surface. The loose flanges serve simply as a powerful clamp to

The cheapest and best method of turning over the flange in the pipe is by the use of the Lovekin expanding and flanging machine. With this machine, pipes of any size, from 2 inches to 24 inches, may be flanged cold, and the work rolled over so perfectly that no machining is necessary. This applies both to copper and wrought steel or iron piping. In the case of copper, of course, it does away entirely with brazed joints, and this will appeal strongly to all engineers, who know the danger of brazed connections. For extremely high pressures in steel pipe, type of joint is shown where the pipe is upset and flanged over while hot.

Screw Propeller Planing Machine.

The machine herewith illustrated and described was recently built for the experimental tank at the Washington navy yard by the Builders Iron Foundry, Providence, R. I., for planing the blades of the screw propellers. By the use of this machine, it is intended to cut a great number of model propellers of different forms for an extensive series of investigations in connection with the ship models tested in the experimental tank. Previous experiments with propellers have been limited to those conducted with propellers mounted independently of the vessel in either moving or still water. The following description of the planing machine is taken from *Machinery*.

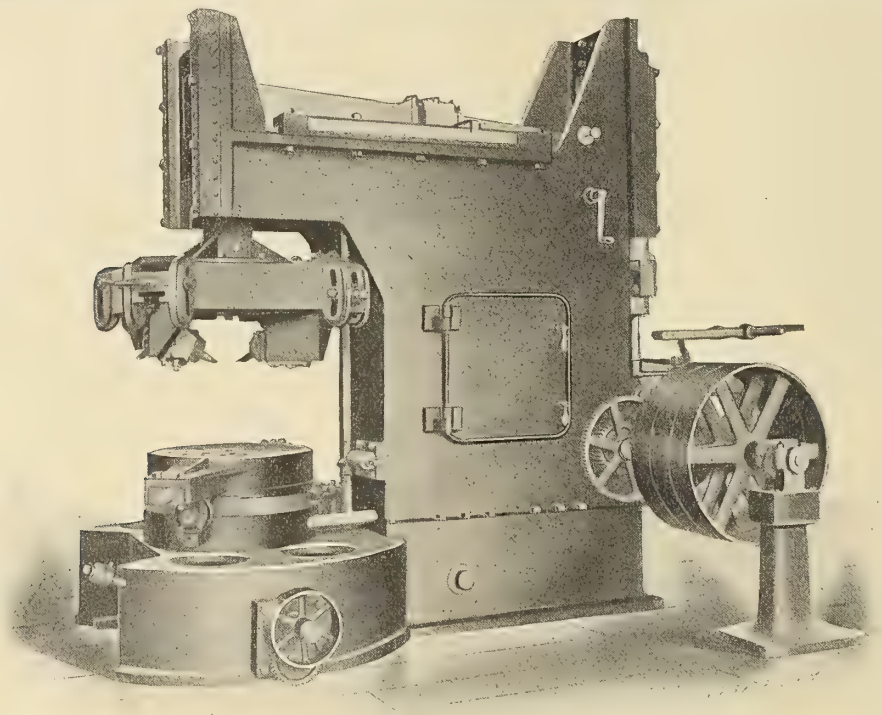


FIG. 1. PROPELLER PLANER FOR MACHINING THE BLADES OF PROPELLERS FOR EXPERIMENTAL PURPOSES.

The general features of design of the planer were outlined by the Navy Department, and were original with Naval Constructor D. W. Taylor. The details of construction, however, were left with the builders, and were worked out by Mr. F. N. Connet, mechanical engineer of the Builders Iron Foundry. The planer operates on rough bronze propeller castings of two, three or four blades, ranging from five inches to 24 inches in diameter, and will finish both the fronts and backs of the blades. The cutting is accomplished by diamond-point or round-nose tools, the tools and work being given such relative motion as to cause the surface of the blade to have the required pitch and form. The propeller is mounted, with its axis vertical, upon a horizontal table, which has a reciprocating rotary motion about its vertical axis. The cutting tools are carried by a cutter head, which has a reciprocating motion in a vertical direction, timed to correspond with the motion of the table. Provision is made for varying the extent of the travel of the cutter head, relative to the motion of the table, by this means varying the pitch of the surface being planed. The machine is driven by a shifting-belt mechanism, similar to a planer of the usual type, the shifting mechanism, in this case, being controlled by dogs clamped in a T-slot on the periphery of the table. Both the cutter head and the table are operated by the same shifting belt, and the feed for the tools is operated by a planer feed mechanism with friction clutch.

In Fig. 1 is a side view of the machine, and in Fig. 2 is a side elevation indicating many details of construction. The belt pulleys are three in number, 30 inches diameter and 5-inch face, the two outside pulleys being loose, and the middle one *A*, in Fig. 3, is tight on its shaft and transmits motion through the bevel gears, *BB*, to the vertical driving shaft, *C*. This shaft consequently changes its direction of rotation with each reversal of pulley *A*, and the reciprocating motions of both cutter head and table are derived from it.

At the lower end of the driving shaft are bevel gears *L* and *M*, Fig. 3, loose on the shaft, but either of which may be set in motion by a clutch which is splined to the shaft. These gears mesh with a third bevel gear, *N*, Fig. 2, and transmit motion through the shaft, *O*, to a worm, *P*, and wormwheel, which drive the table, and give it its reciprocating motion. The object of the two bevel gears and clutch on the driving shaft is to reverse the direction of rotation of the table, relative to the motion of the driving shaft, so that either right- or left-hand propellers may be planed.

At the upper end of the driving shaft is a double-threaded screw, 3 1-2 inches diameter, 3-4 inch lead, which runs in an adjustable bronze nut, forming part of the crosshead, *E*. This crosshead is connected with

the walking beam, *F*, Fig. 2, by a sliding and pivoted joint, and the walking beam, at its opposite end, is similarly connected with another crosshead carrying the tool head *I*. It is evident that in the production of the surfaces of a propeller blade, the motions of the blade and tool are entirely analogous to the motions of the corresponding parts when thread cutting in a lathe. That is, for a propeller of uniform pitch, the propeller must rotate uniformly, and the tool must advance uniformly just as the work turns uniformly, and the carriage and tool post advance uniformly in the case of the engine lathe. In the propeller planer the driving shaft has a uniform rotary reciprocating motion, received from the driving belt, as we have already seen, and this is reproduced in the motion of the table through the bevel-and-worm-gear connections. The design of the travel of crosshead *E* is always relatively the same as the travel of the table, it is evident that adjustment of position of the fulcrum of the walking beam enables propellers of various pitches to be planed. To facilitate setting the machine, the frame adjacent to the walking beam is graduated, and indicates where the fulcrum must be set to correctly plane a propeller of given pitch. The maximum movement of crosshead *E* is 8 inches, and the movement of the cutter head can be varied from 1 inch to 12 inches.

The work table of the machine is 27 inches in diameter, and is arranged so that it can be raised or lowered either by hand or by power, to bring the work into position for machining. The gearing for this purpose is shown at *R*, in Fig. 2. Provision is also made for the automatic lifting of the table while the

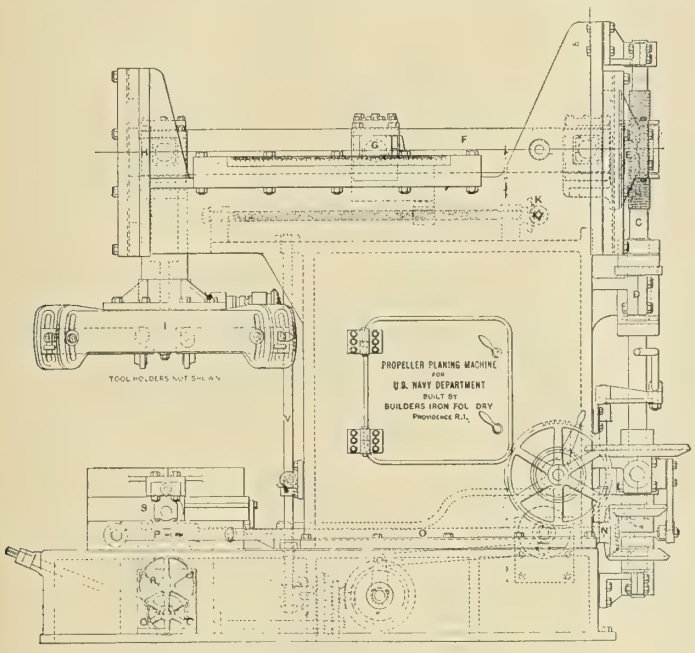


FIG. 2. SIDE ELEVATION.

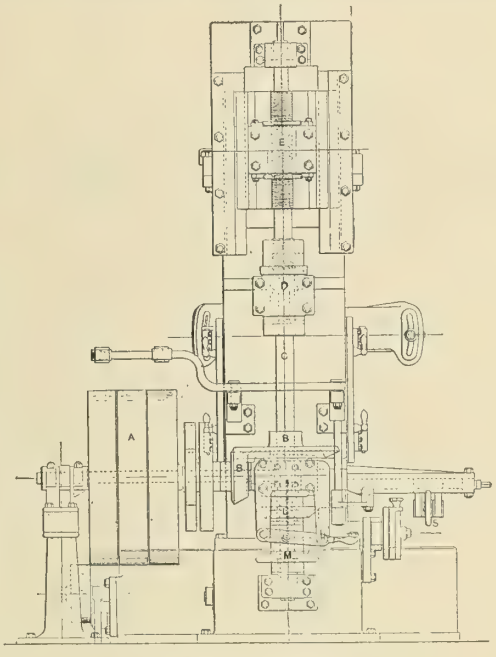


FIG. 3. END ELEVATION.

the walking beam, also, is such as to give a uniform advance and return to the cutter head, this being accomplished by the crosshead at each end, guided in a straight, vertical line, in connection with the walking beam, which is so arranged that each end slides in a block pivoted to the crosshead at that end. The arrangement maintains a constant ratio between the lengths of the two arms of the walking beam, whatever the angle of inclination, and the motion of the cutter head thus accurately reproduces the motion transmitted by the screw at the upper end of the driving shaft, *C*.

The walking beam is a steel forging of rectangular cross section and has an adjustable fulcrum consisting of a trunnion block, which can be clamped to the walking beam at any desired position along its length. This block has two trunnions supported in boxes carried by a casting which can be adjusted to any desired position by means of a crank, *K*, Fig. 2, a pair of bevel gears, and a screw. The adjustment of the position of the fulcrum varies the distance traveled by the cutter head, *I*, for each inch of travel of crosshead, *E*; and as machine is in operation, through the use of two cam surfaces, bolted to the base of the machine, or diametrically opposite sides of the table. By raising the table during the downward, or cutting stroke of the tool, the effect is the same as though the cutting speed of the tool were changed, thus allowing the propeller to rotate a greater or less amount, according to the shape of the cam, for every inch of travel of the tool, and producing a propeller of variable pitch. By laying out suitable cams any desired variation in pitch can thus be obtained. There are two horizontal arms, extending radially outward from the table, as shown clearly in the half-tone illustrations, each of which carries a sliding block supporting a steel roll. These rolls ride up and down on the cam surfaces as the table reciprocates, alternately raising and lowering the table. Provision is made for feeding the rolls out or in along the radial arms, their motion keeping pace with the out or in feed of the cutting tools; and by making the cam with a surface of changing curvature, different pitches can be employed for the inner and outer ends of the propeller blades.

In Fig. 4 is a view of the under side of one of the cutter heads. This head has four radial slots or channels, in each of which are slides or ways that carry the tool heads. The cutter head is designed for planing either two- or four-bladed propellers, and there is a second head having three radial slots spaced 60 degrees apart, for planing three-bladed propellers. The specifications for the machine called for the feeding of the tools in a radial direction in a horizontal plane, and also the ways on which the tool heads traveled should be capable of being swiveled up to 10 degrees in either direction with the horizontal, the object being to provide for propellers having rake to the blades. The slides are pivoted at their inner ends, and are clamped in position by two bolts at their outer ends. Each tool head carries a tool post attached to a swiveling apron, similar to the tool heads of planers and shapers, and two sets are furnished, one right-hand and one left-hand, for cutting right- and left-hand screws, and

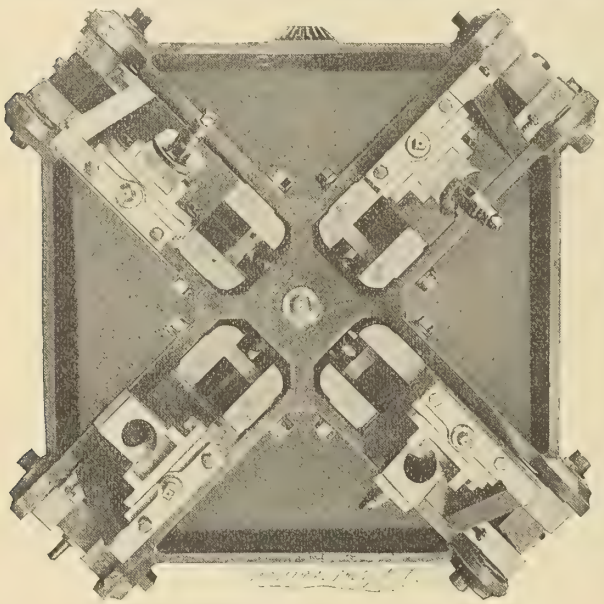


FIG. 4. VIEW OF CUTTER HEAD FROM UNDERNEATH.

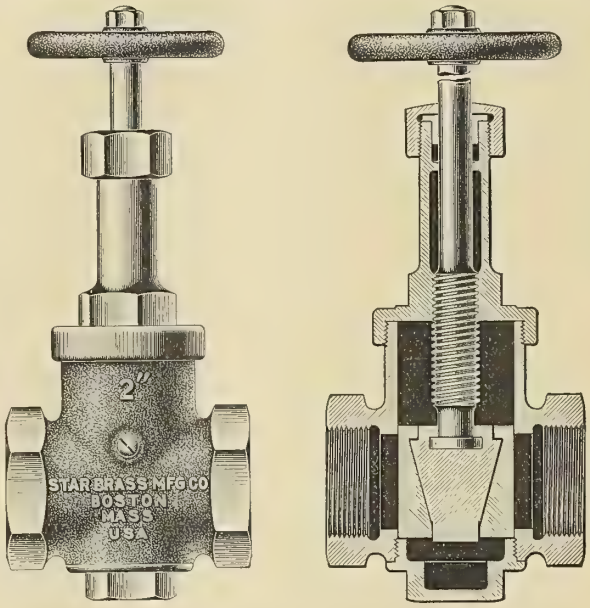
all of them have adjusting screws for vertical adjustment of the tools.

The feeds for the tool heads are derived from a central stud gearing with feed screws, which extend radially one for each slide. The feed screws have universal joints at their inner ends, to allow motion to be transmitted when the slides are tilted above or below the horizontal. The central feed stud derives its motion from the bevel gear seen on the outside of the cutter head at top of the engraving, Fig 4, and this gear in turn meshes with a gear on the splined feed shaft, *V*, in Fig. 2. At the lower part of Fig 2 the gearing connecting this feed shaft with the rachet wheel operated by the friction feed mechanism of the planer is shown by dotted lines. The cam rollers on the table arms also derive their feed motion from the same device.

The machine is back-geared, and is belted to a countershaft driven by an electric motor. It weighs about 10 tons, is 8 feet 10 inches high, 4 feet 10 inches wide, and 8 feet 3 inches long. It works to the entire satisfaction of the government officials and the builders.

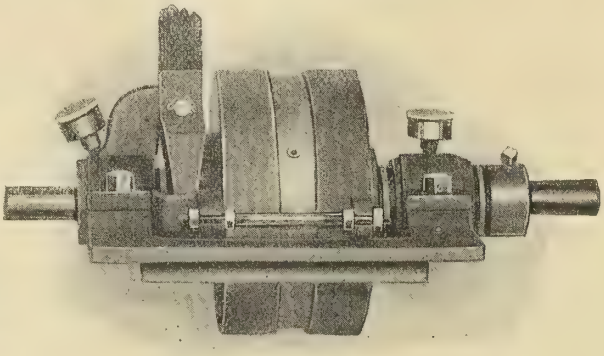
Improved Blow-off Valve

A valve which is guaranteed to close tight and always remain so, is not affected in any way by scale or dirt is made by the Star Brass Manufacturing Company, 114 East Dedham street, Boston, Mass. The valve will work equally well under high or low steam pressures. It is made entirely of composition. As shown in the cut, the operation of closing consists of the central wedge expanding a half piston which is very accurately



OUTSIDE AND SECTIONAL VIEWS OF IMPROVED EXPANDING WEDGE BLOW-OFF VALVE.

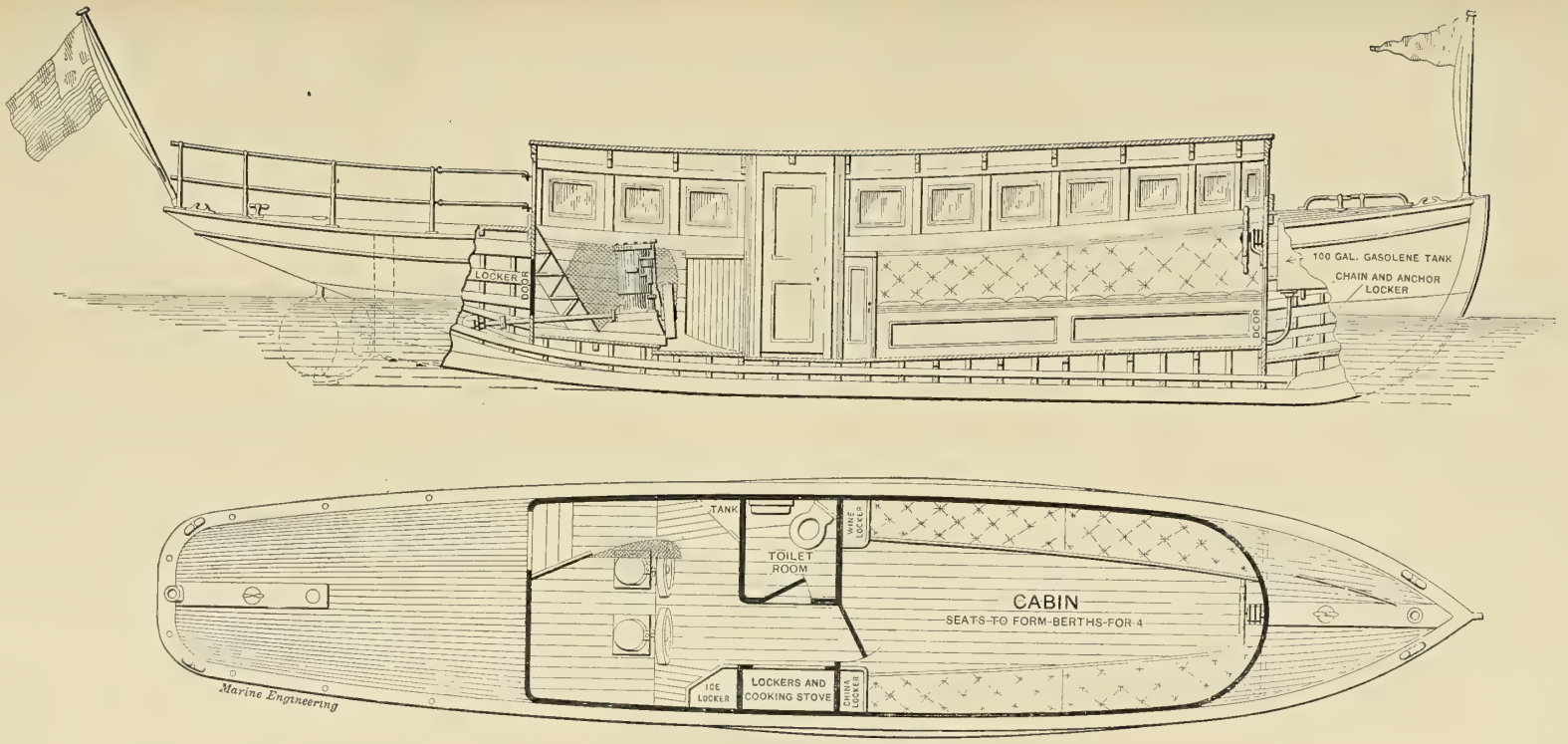
fitted to the cylindrical chamber in the valve body. When opening, the first movement of the valve spindle relieves the pressure between the wedge and the piston when further turning of the handle raises the piston until the full opening of the valve is reached.



A NEW FORM OF REVERSING CLUTCH.

Reversing Clutch for Marine Engines.

The difficulty of reversing the motion of a propeller driven by a gasoline engine has probably more than any other feature caused trouble. As the usual type of gasoline engine does not reverse, special gear has to be fitted for reversing the propeller, or changing the pitch of the blades, to secure a backward motion. The reversing clutch here illustrated is one for which a claim is made



TWIN SCREW MOTOR LAUNCH JOSEPHINE.

of very smooth running, the operator has perfect control of the propeller, and reversal of motion can be obtained without shock to the engine, gear or propeller.

The engine is, of course, run forward at all times, but when the vertical lever, shown broken off at the top of the left-hand side of cut, is set forward a frictional hood is forced upon the frictional cone at the centre. The hood is attached to the forward end of the shaft and the cone to the propeller end. For reversal, a second hood, driven by gearing, is forced upon the cone. These gears are always in mesh, but never in use except when the propeller is reversed. Also there is small liability to breakage, as connection is made entirely by friction.

The clutch is fitted with three sets of ball-thrust bearings, thereby reducing the friction to a minimum, and all parts are well fitted and easily accessible. The frame makes the propeller as rigid as it would be if solid from the engine out. The device may be connected with any marine engine, and takes up but very little space. It is made by the Holliday Manufacturing and Engineering Company, 160 Bunker street, Chicago, Ill.

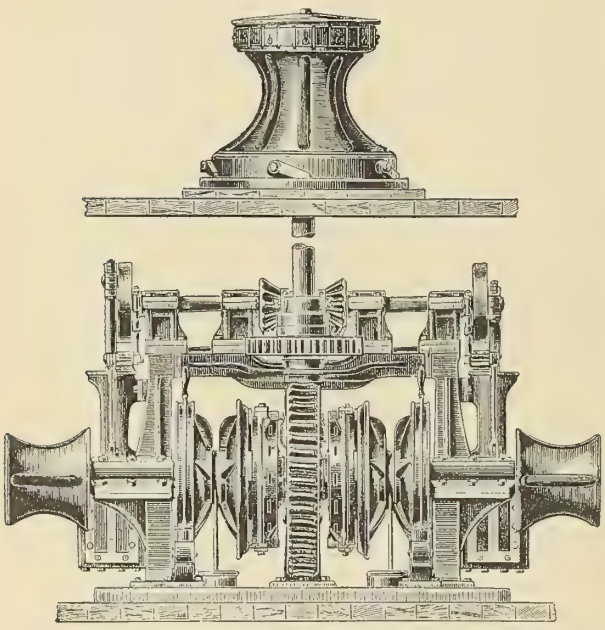
Twin Motor Launch Josephine.

One of the new small boats coming out this season is to be named the *Josephine,* and is built by E. C. Johnston and Company, Nyack, N. Y., formerly the Pinckney Company. The boat is to be 40 feet long, 8 feet beam, 2 feet 9 inches deep, and is for Commodore E. H. Luebbers, Jr., of the United States Life Saving Corps. The launch is equipped with two motors six horse power each. The reversing and operating rods are placed near the steering wheel at the forward end so that the engine is controlled by the wheelsman. The boat is furnished throughout in a substantial manner and handsomely finished, being fitted more for comfort than speed, but ten miles an hour are to be attained. She is lighted throughout by electricity.

The *Josephine* is to be added to the flotilla of the Hudson River Yacht Club, of which the owner is a member.

Steam Capstan Windlasses.

The Manton windlass, now made by the Rusden Machine Company, of Warren, R. I., comprises many special distinctive features. From the illustration of the steam capstan windlass, given on this page, it will be seen that the machine is very compact and it is claimed takes only one-half of the floor space occupied by corresponding machines of other makes. The capstan can run independently of the windlass, being arranged to work by hand when without steam. The locking key is always inside, so in an emergency can



STEAM CAPSTAN WINDLASS.

be seen whether the windlass is locked without stopping to try. The thrust bearing of the worm has a firm foundation on the bedplate, thus preventing any liability of twist or breaking. A windlass may be driven either way without reversing engines and can also be rolled in or out by simply taking off the bitt caps without disturbing any other part of the machine. The deck pipes being set angling supply the chain easily and allow a better grip on the wildcat.

There are ten sizes of steam capstans made by this company for handling chains from 1 inch to 2 1-8 inches. The machines are simple and built in a thoroughly workmanlike manner, the working parts being made of very best material. The pump brake attachment is supplied when desired.

The Shipping Bill Passed.—On April 8 the House of Representatives passed the Philippine shipping bill, which provides that no merchandise for passengers, except supplies for the Army or Navy, shall be transported by sea, under penalty of forfeiture, between the United States and the Philippine Islands in any vessels except those of the United States The bill was amended to become operative July 1, 1906, otherwise it is similar to the Senate bill already passed.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of April 9, 1904, the following degree of completion of vessels building for the United States Navy:

				Degree of Completion. Per Cent.	
				Mar. 1.	Apr. 1.
BATTLESHIPS.					
Ohio	18 knots.	Union Iron Works		88	91
Virginia	19 "	Newport News Co		55	56.8
Nebraska	19 "	Moran Brothers Co		41.6	44.5
Georgia	19 "	Bath Iron Works		47.6	49.91
New Jersey	19 "	Fore River S. and E. Co		52.1	55.3
Rhode Island	19 "	Fore River S. and E. Co		54	57
Connecticut	18 "	Navy Yard, New York, N. Y.		30.86	34.56
Louisiana	18 "	Newport News Co		40.56	44.27
Vermont	18 "	Fore River S. and E. Co		4.6	5.6
Kansas	18 "	New York Shipbuilding Co.		5.2	6.3
Minnesota	18 "	Newport News Co		18.29	21.65
Mississippi	17 "	Wm. Cramp and Sons		0	0.7
Idaho	17 "	Wm. Cramp and Sons		0	0.6
ARMORED CRUISERS.					
Pennsylvania	22 knots.	William Cramp and Sons		68.6	71.2
West Virginia	22 "	Newport News Co.		76.76	80.25
California	22 "	Union Iron Works		56.5	58
Colorado	22 "	William Cramp and Sons		73	77.5
Maryland	22 "	Newport News Co		71.22	75.88
South Dakota	22 "	Union Iron Works		52.5	54
Tennessee	22 "	William Cramp and Sons		19.5	23.4
Washington	22 "	New York S. B. Co		17	20.9
PROTECTED CRUISERS.					
Denver	17 knots.	Neafie and Levy		98	99
Des Moines	16½ "	Fore River S. and E. Co		99.5	100
Chattanooga	16½ "	Lewis Nixon		72.6	75.71
Galveston	16½ "	Wm. R. Trigg Co		73.5	75
St. Louis	22 "	Neafie and Levy Co		38	40.9
Milwaukee	22 "	Union Iron Works		44.5	46
Charleston	22 "	Newport News Co		64.5	67.2
GUNBOATS.					
Dubuque	12 knots.	Gas Engine and Power Co.		29.1	33.5
Paducah	12 "	Gas Engine and Power Co.		25.5	29.1
TRAINING SHIPS.					
Cumberland	Sails	Navy Yard, Boston		26	28.5
Intrepid	"	Navy Yard, Mare Island		9	12
TRAINING BRIG.					
Boxer	Sails	Navy Yard, Portsmouth		20	28
TORPEDO BOATS.					
Stringham	30 knots.	Harlan and Hollingsworth		93	93
Goldsborough	30 "	Wolff and Zwicker		99	99
Blakely	26 "	George Lawley and Son		99	99
Nicholson	26 "	Lewis Nixon		99	99
O'Brien	26 "	Lewis Nixon		98	98

Quarterly Shipbuilding Returns.—The Bureau of Navigation reports 177 sail and steam vessels of 55,066 gross tons built in the United States and officially numbered during the quarter ended March 31, 1904. During the corresponding quarter ended March 31, 1903, 187 sail and steam vessels of 58,588 gross tons were built in the United States and officially numbered. There is an increase in the sailing wood tonnage built on the Atlantic Coast during this quarter and slight increase in the steel tonnage of the Atlantic and a large falling off in the steel steam tonnage in the Pacific. The total tonnage built during the nine months concluded March 31, 1904, was 232,133 gross tons, and during the corresponding months of last year, 231,187 gross tons.

THE USE OF SUPERHEATED STEAM.—II.*

BY PROF. STORM BULL.

In the discussion which followed the reading of the paper on this topic, and in answer to the questions addressed the author, the following facts were brought out:

In answer to the question, why the radiation in the cylinders coated on the inside with moisture is greater than when there is no moisture on the inside, Professor Bull stated he had found by experiment that the heat lost by the steam in an ordinary engine using saturated steam is always increased very rapidly with the adherence of the moisture to the metal surface. If you can keep that surface dry there is a very rapid decrease of condensation. Suppose you use superheated steam, then first of all the steam has to lose a great amount of heat before it will condense, consequently for a long time no moisture will be found, and the rate of change will be greatly reduced. It is only where the moisture covers the walls that this rapid condensation takes place. These conclusions have, of course, only been reached by means of experiment.

With superheat it appears that there is less gained in economy by using high expansion in engines where there are more than two stages of expansion than with reciprocating engines.

European makers of the highest grade of engines using superheated steam have abandoned the Corliss valve and are now using poppet valves, except for high speed of revolutions, when piston valves are substituted. A greater economy is shown with superheat used with the turbine than with the compound engine. It is possible to use ordinary rubber gaskets, but they must be of the very best quality. As the temperature is increased two or three hundred degrees, allowances must be made in the design of the engine for nearly double the expansion, and therefore engines designed for saturated steam cannot run with a high degree of superheat without more or less changes.

In reply to a written communication from Mr. C. W. E. Clark, on the amount of superheat for steam and reciprocating engines, and the cost of repairs and upkeep, Professor Bull stated that, from his personal inspection, he found that most plants constructed in Germany during the last five years used superheat of at least 200 degrees Fahrenheit, and that with respect to lubrication and maintenance they have been very satisfactory. As to the type of superheater, the question seems yet to be an open one, although it looks as if in the last few years the wrought iron type has been the most popular. While with the independently fired superheater the control is much easier, yet the question of control is only a part of the general question for the cost of installation and the better utilization of hot gases under the boiler must be taken into consideration.

In reply to a communication by Mr. A. Sorge on the practical side of running with superheated steam, the speaker stated that while it would not pay to install a superheater next to a coal mine where the cost of fuel is very low, yet, just as in Europe, so in the United States there are many places where it will pay to use superheated steam and the most economical engines.

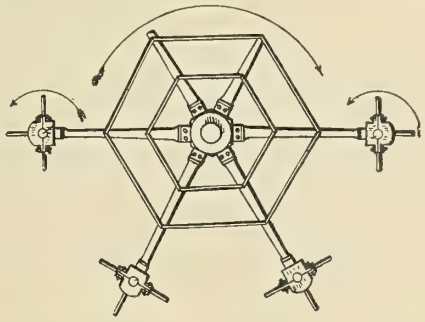
*Discussion on paper presented before the Western Society of Engineers, November, 1903.

SELECTED MARINE PATENTS.

753,217. MEANS FOR REMOVING SAND-BARS. EUGENE H. ALLMAN, MOBILE, ALA.

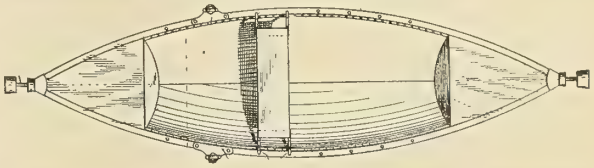
Claim.—1. An improved apparatus for the purpose specified, comprising a float, a framework applied thereto, a series of standards supported in said framework, and a series of plows secured to the lower ends of the standards which are adapted to project below the float. Six claims.

753,358. PADDLE-WHEEL. THOMAS J. CAMPBELL, Economy, Pa.



2. A paddle-wheel, comprising a shaft, hubs thereon spaced apart, radial spokes projecting from the hubs, braces connecting the spokes to the respective hubs, bearings in the spokes, and revoluble paddles, having shafts journaled in said bearings and disposed parallel with the shaft of the wheel, said revoluble paddles having radially-disposed blades, which converge to and are joined at their respective axes. Two claims.

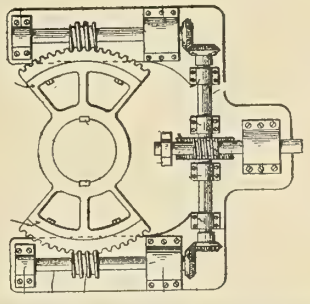
753,425. METAL BOAT. SYLVESTER D. NOEL, INDIANAPOLIS, IND.



Claim.—1. The combination with a boat having an angle-iron gunwale with a horizontal top member, said member having a plurality of equidistant holes, of removable seat and oar-lock attachments adapted to be supported from said horizontal member and fastenings therefor entering said holes. Three claims.

753,445. ARTIFICIAL HORIZON FOR USE OF MARINERS. JAMES M. STRATTON, BROOKLYN, N. Y. Two claims.

753,576. STEERING-GEAR. HERBERT W. HOOVER, NEWPORT NEWS, VA.



Claim.—1. The combination with the rudder-stock, the toothed gear secured thereto and composed of sections as described, the foundation or support and bearing-ring for said gear, shafts provided with worm-wheels, said worm-wheels engaging said toothed gear, gear-wheels on said shafts engaging similar wheels on a transverse shaft, a gear-wheel on the transverse shaft, and a shaft, provided with a worm-wheel engaging said last-mentioned gear-wheel; and means for driving said shaft. Two claims.

753,717. FISH-TAIL PROPELLER. ZDENKO von LIMBECK, VIENNA, AUSTRO-HUNGARY. Five claims.

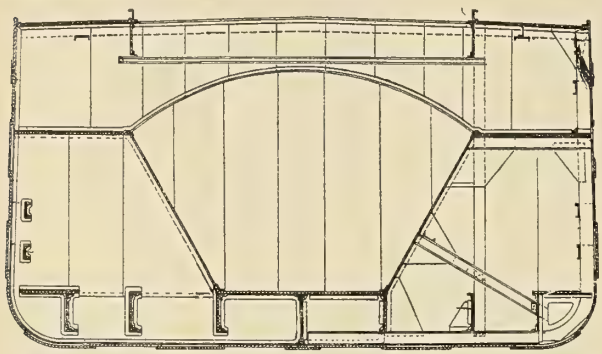
753,948. INSTRUMENT FOR TAKING SOUNDINGS. EUSTACE E. WIGZELL, LONDON, ENGLAND. Four claims.

754,054. SUBMARINE PRESERVING AND ANTIFOULING COMPOSITION. MATTHEW H. DEVEY, PHILADELPHIA, PA. FILED DEC. 5, 1901. RENEWED JAN. 11, 1904. SERIAL NO. 188,666.

Claim.—1. A compound consisting of boiled linseed-oil, litharge, sulfate of copper, Venice turpentine, Portland cement, and ground glass. Three claims.

754,107. SHIP CONSTRUCTION. AUGUSTUS B. WOLVIN, DULUTH, MINN.

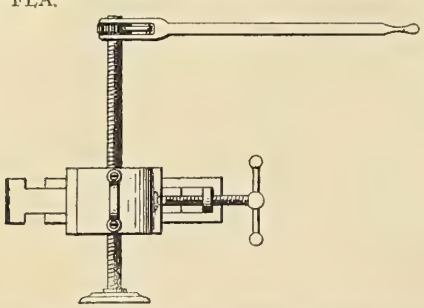
Claim.—1. A steel ship having an unobstructed trough-shaped cargo-hold, which is located midway between the sides of the ship, and which has a floor which does not extend as close to the sides as do the hatchways, and which has outwardly-flaring side walls extending from the floor to the main-deck.



2. A steel ship having a plurality of keelsons, a floor laid thereon, a shelf-like main-deck extending inward from the sides of the ship, and longitudinally-extended partitions which are inclined outwardly from the floor to the edges of said main-deck.

3. In a ship construction, the combination with a hull, of side frames, and a plurality of keelsons, vertical stanchions, main-deck beams secured to said stanchions and side frames, a floor secured upon the keelsons and longitudinally-extended partitions which are outwardly inclined from the floor to the inner edges of said main-deck, and are located wholly between the stanchions and the centre of the ship. Three claims.

754,115. SHIP-BUILDER'S CLAMP. NEWTON C. BAILEY, TAMPA, FLA.



Claim.—1. In a clamp, a block having a screw-threaded bore, a jaw rigidly mounted on said block, a jaw slidably mounted on the block, an ear on said jaw, a screw-rod mounted in a screw-threaded bore in said ear and journaled in the block, and a screw-plunger intermembering with the screw-threaded bore in the block, having a plunger-head on one end and an actuating means on the other end. Two claims.

754,222. BALLAST-COMPARTMENT FOR SUBMARINE BOATS. SIMON LAKE, BRIDGEPORT, CONN.

Claim.—1. In a submarine boat, the combination with a water-ballast compartment and means for controlling its fluid contents, of a movable partition fitted to said ballast-compartment and acting idly in respect of the said controlling means to adjust the capacity of that portion of said compartment containing the water ballast to correspond with the volume of its fluid contents. Five claims.

754,464. SIGHTING OR OBSERVING TUBE FOR VESSELS. SIMON LAKE, BRIDGEPORT, CONN.

Claim.—1. The combination with a vessel, of a sighting-tube having in its upper or outer end a reflector movably mounted therein for receiving and reflecting inwardly an image of an external object, and means connected with said reflector and automatically controlled independently of the trim of the vessel for maintaining said reflector trained toward external objects at the level of the water. Five claims.

754,611. SUBMARINE DREDGING AND SLUICING DEVICE. ROBERT G. RILEY, SEATTLE, WASH. One claim.

754,620. VALVE-GEARING FOR STEAM-ENGINES. JAMES B. STANWOOD, CINCINNATI, O. Five claims.

754,710. PROPELLING APPARATUS FOR VESSELS. MARX P. SCHETZEL, OAKLAND, CAL. One claim.

755,064. APPARATUS FOR DISCHARGING LOOSE CARGO FROM VESSELS. HARRY SHOOSMITH, ORMISTON, ERITH, ENGLAND.

Claim.—1. For facilitating the discharge of loose cargo, a navigable vessel having a cargo-discharge opening through the lower portion of its hull, a water-tight door secured to said vessel and adapted to close said opening, a supplementary door secured to said vessel inside said water-tight door, said two doors being independently attached and supported, whereby the weight of the loose cargo on the inner door will not be transmitted to the outer water-tight door.

2. For facilitating the discharge of loose cargo, a navigable vessel having cargo-discharge openings through the lower portion of its hull, water-tight doors hinged at one side to said vessel so as to open outward, hinge-bolts attached to said vessel and adapted to hold said doors in a positioon to close said openings in a water-tight manner, and supplementary doors hinged to said vessel at the inner portion of said openings and arranged to open outward. Two claims.

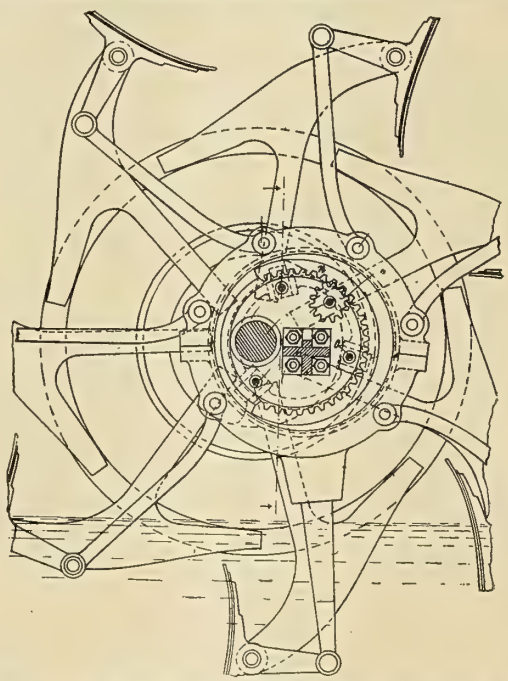
755,241. LIFE-BOAT-LAUNCHING APPARATUS. WILBUR F. POWERS, CAMDEN, N. J.

Claim.—1. In a life-boat-launching apparatus, the combination with davits hinged to swing outwardly, of a pair of racks mounted to reciprocate in suitable ways parallel with the planes of oscillation of the davits, motor mechanism for positively actuating said racks, co-operating cables and paying-out mechanism automatically and positively operated simultaneously with the movement of the racks. Five claims.

755,536. APPARATUS FOR RAISING OR SINKING VESSELS IN LOCK-CHAMBERS. FERDINAND POKORNY, MORAVSKA OSTRAVA, AUSTRIA-HUNGARY. Four claims.

755,426. PROPELLER. JEROME I. WOOD, PHILADELPHIA, PA. One claim.

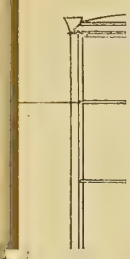
754,991. PADDLE-WHEEL FOR VESSELS. ERNST H. H. GOTTLEBE, MAGDEBURG, GERMANY.

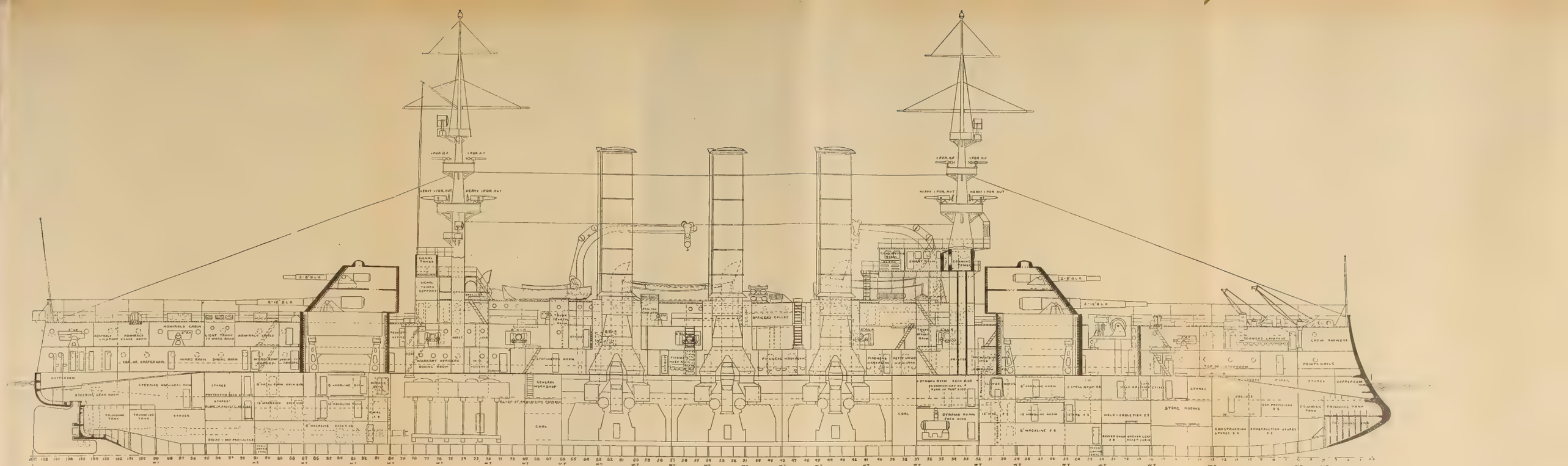


Claim.—1. A paddle-wheel with adjustable angle-paddles comprising a rotary shaft, an eccentric surrounding said shaft, an eccentric-ring on said eccentric, an outer eccentric-ring, blade-carrying levers mounted on said outer eccentric-ring and means for partly rotating the inner eccentric-ring relatively to the eccentric. Three claims.

Electric Units.—An interesting paper on the subject of electric units will be introduced at the St. Louis exhibition to the congress of electricians by an Austrian civil engineer and specialist in electrotechnic. This paper will be based on a new unit of time replacing that of the second, in accordance with a new division of the circle (angles). A year ago Dr. Gino Dompieri published in German a pamphlet on the subject, which was favorably commented on by the Continental press. An abridged version of this pamphlet may be obtained in English adapted to American readers.

Wrecks and Casualties for February.—The Administration of the Bureau Veritas, Internation Registry of Shipping, has just published the list of marine disasters reported during the month of February, 1904, as follows: There were 61 sailing vessels lost from various causes, 29 of which were from stranding, 5 from collision, 12 condemned, 7 abandoned, 4 foundered, 3 missing, and 1 from fire. Of this total, 20 sailed under the American flag. Of the steamers, 10 were lost from stranding, 6 from collision, 3 foundered, 5 condemned and 2 abandoned.





SUPPLEMENT TO *MARINE ENGINEERING*, JUNE, 1904.

INBOARD PROFILE AND DECK PLANS OF THE 15,000-TON UNITED STATES BATTLESHIP VIRGINIA, AND CLASS, BUILT BY THE NEWPORT NEWS SHIPBUILDING AND DRY-DOCK COMPANY.

INDEXED

Marine Engineering

Vol. IX. JUNE, 1904. No. 6

PATENT OFFICE

THE LATEST UNITED STATES BATTLESHIP LAUNCHED—THE VIRGINIA, OF 15,000-TONS DISPLACEMENT.

Length over all, 435 feet; breadth, extreme, 76 feet 2 1-2 inches; draft, normal, 23 feet 9 inches; speed, 19 knots; I. H. P., 19,000.

Armament: four 12-in. B. L. R.; eight 8-in. B. L. R.; twelve 6-in. R. F. G. Secondary battery, 42 guns. Armor: belt, 11 to 8 inches; casemate, 6 inches; turrets, 12 and 6 inches. Complement, 800 men.

[Photograph by Muller.]

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THE UNITED STATES BATTLESHIP VIRGINIA.

On the fifth day of April, in the presence of thousands of spectators, before the governor of the state of Virginia and his staff, members of the legislature, and many distinguished visitors, the United States battleship No. 13, the *Virginia,* was launched at the works of the Newport News Shipbuilding and Dry-Dock Company. The *Virginia* is the first to be launched of the five battleships appropriated for by the acts of Congress of March 3 and June 7, 1899, her sister ships being the *Nebraska, Georgia, New Jersey,* and *Rhode Island.* She represents the highest development of the battleship at the time the contract for her construction was made, and she is of a powerful and well-balanced design.

With a load water-line length of 435 feet, an extreme breadth at load-water line of 76 feet 2 1-2 inches, a mean trial draft of 23 feet 9 inches, and a trial displacement of 14,950 tons, she is, at present, the largest United States battleship off the stocks. She was built on the designs of the Navy Department as to hull and machinery, the details being worked out by the contractors, but all subject to the Department's approval. She is required on trial to make an average sea speed of 19 knots an hour for four consecutive hours, and there are the usual penalties for under speed and delay in delivery.

The *Virginia* is a twin-screw, first-class battleship, built of steel, having a double bottom and well divided into water-tight compartments.. In general appearance she resembles others of the more recent battleships, differing from some, however, in that her after body is carried to the same height as the forward body, thus securing more freeboard aft, raising the after turret to the same height above the water line as the forward turret, thereby increasing the efficiency of the after guns and adding greatly to the comfort of the living quarters in the after part of the ship. There are two steel military masts, with upper and lower fighting tops, signal yards, and search light platforms, and there are three smoke pipes.

ARMAMENT.

The armament of the *Virginia* class is noticeable in that its design shows a return to the 8-inch rifle, which had been omitted in the *Illinois* and *Maine* classes, immediately preceding this. In the two former classes there was no intermediate size between the 13- or 12-inch turret guns and the 6-inch broadside guns. The main battery of the *Virginia* consists of four 12-inch, 40-caliber B. L. R., eight 8-inch B. L. R., and twelve 6-inch R. F. G. Compared with the four 13-inch and fourteen 6-inch guns of the *Alabama,* or the four 12-inch and sixteen 6-inch guns of the *Missouri,* it would seem that the *Virginia* has a much superior battery to the earlier ships, though the increase has entailed a considerably greater displacement. The total estimated weight of guns, mounts, and shields is 5 1-2 per cent. of the displacement.

There is a powerful secondary battery consisting of twelve 3-inch rapid-fire guns, twelve 3-pounder semi-automatic, four 1-pounder heavy automatic, four 1-pounder heavy rapid fire, two 3-inch field pieces, two .30-caliber machine, and six .30-caliber automatic guns; there are also two submerged torpedo tubes.

ARMOR.

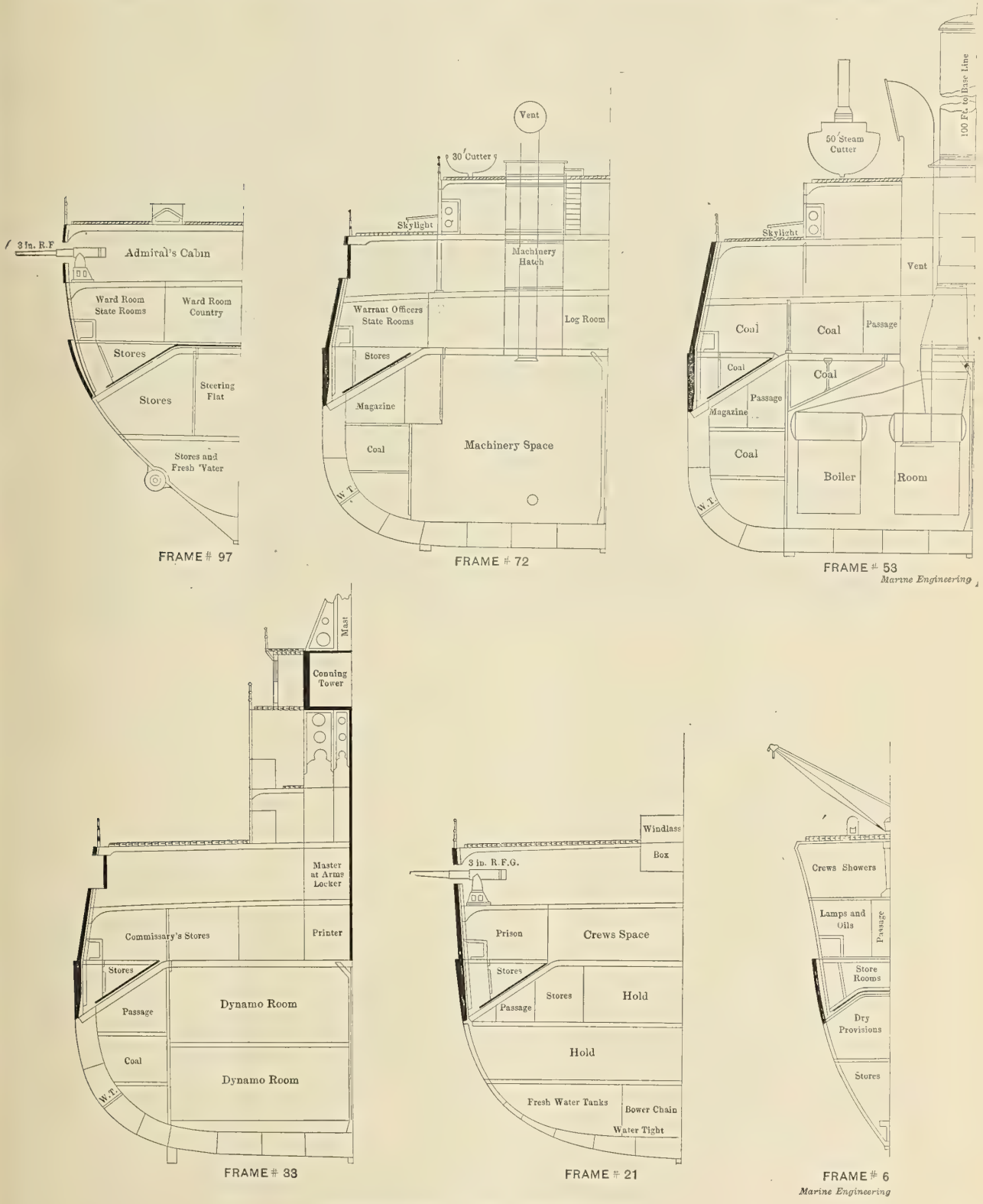
The armor, furnished by the government, is placed and secured by the contractor. All the armor is face hardened, that over 5 inches thick by the Krupp process, that 5 inches or less by the Harvey process. There is a complete water-line armor belt, 8 feet deeep, and extending from stem to stern. For the length of the machinery space, amidships, this belt is 11 inches thick from the top to within about 3 feet from bottom, from which point it tapers to 8 inches. From the limits of the machinery space to the bow and stern the water-line belt is reduced in thickness, in four courses, as follows: first, 9 inches tapering to 6 inches; second, 6 inches tapering to 4 1-2 inches; third, 5 inches tapering to 4 inches; fourth, uniformly 4 inches to bow and stern of the ship. Above the heaviest part of the water-line belt and extending up to the main deck, the ship is protected by casemate armor 6 inches thick, while running athwartships, from the after end of casemate armor to the after barbette, and directly across the ship about four frames forward of the forward barbette, is a wall of armor 6 inches thick, thus forming a central citidal.

Within this casemate, on the gun deck, six on a side, are placed the 6-inch broadside guns, each gun being isolated from its neighbors by 2 1-2-inch and 1 1-2-inch armor. The barbettes of the 12-inch guns are 10 inches thick in front reduced to 7 1-2 inches in thickness in the rear, and the turrets are 12 inches thick. The 8-inch turrets, one of which is superposed on each 12-inch turret, the other two being placed, one on each beam, a little forward of amidships, are formed of 6-inch armor, with 6 1-2-inch port plates. All turrets are elliptical and balanced, and have inclined fronts. Each is turned by an electric motor placed directly below the turret. Each turret also has a washing-out system for each gun and an electric smoke blower for blowing the smoke and gases from the bore of the guns. The total estimated weight of the protection is 25.2 per cent. of the displacement.

The protective deck, between the athwartship casemates, is formed of two courses of 30-pound steel plates, to which is riveted on the slope a 1 1-2-inch nickel steel plate, making the total thickness 3 inches. At bow and stern this deck slopes down to below the water line and is firmly secured to the stem and stern castings. There is also a 3-foot coffer dam, packed with cellulose, extending the whole length of the vessel on each side above the protective deck. The conning tower is 9 inches thick, and the armored tube 5 inches thick, and there will also be a signal tower with walls 5 inches thick. The magazines are below the protective deck and so arranged that about one-half the ammunition shall be stowed at each end of the ship.

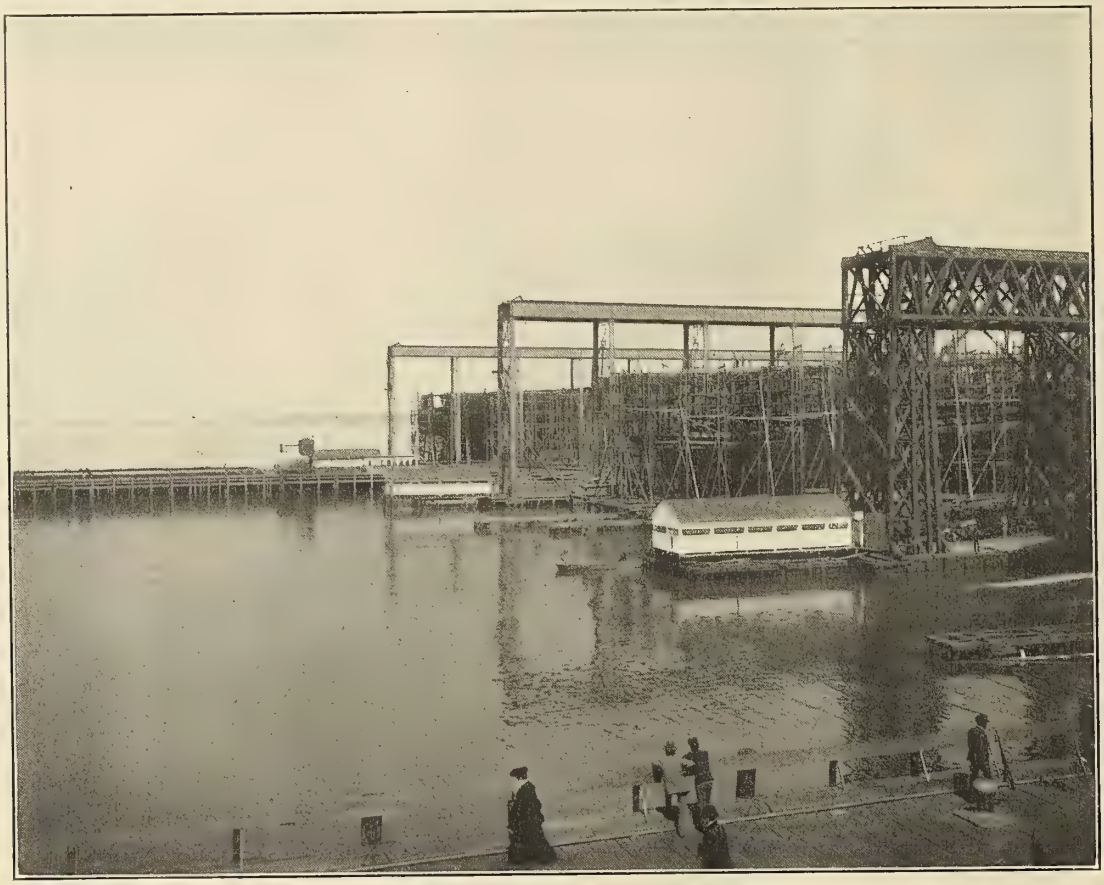
In such a vessel as the *Virginia,* where the battery is composed of so many rapid-fire guns, the ammunition supply must be ample and reliable. Leading fore and aft from the magazines, on each side of the ship, is an ammunition passage, and at proper intervals, so placed as to be conveniently near the guns to be supplied, are electric ammunition hoists of 2 1-2 or 3 horse power each. The ammunition is conveyed along these passages by trolleys until it reaches its proper hoist, near which is a ready-service magazine, where it is held until needed, when it can be quickly placed on the hoist and raised

to the gun. There will be racks near the 6-inch guns of sufficient capacity to stow at least one-tenth the full a charge to the loading position in ten seconds. The rate at which ammunition shall be supplied to the guns



SECTIONS OF UNITED STATES BATTLESHIP VIRGINIA.

supply of shell for each gun. The ammunition for the turrets is supplied by electric hoists leading direct from the handling rooms to the turrets and capable of hoisting is as follows: for each 12-inch gun, one round every 90 seconds; for each 8-inch gun, one round every 50 seconds; for each 6-inch gun, one round every 10



LAUNCHING THE UNITED STATES BATTLESHIP VIRGINIA FROM THE YARDS OF THE

seconds; for each 14-pounder, one round every 4 seconds; for each 3-pounder, one round every 2 seconds, and for each 1-pounder, 100 rounds a minute.

On the extreme forward part of the gun deck are located the waterclosets and shower baths for the crew; the space between turrets on this deck is occupied by the 6-inch broadside battery, abaft which, on each side of ship, are offices for the admiral—for the ship is fitted as a flagship—captain, navigator, and ordnance officer, state rooms and lavatory for the captain and chief-of-staff, and six ward room officers' state rooms, while still further aft is the admiral's cabin, state room, reception room, lavatory, and after-cabin, and the captain's cabin. These quarters are all commodious and roomy and conveniently arranged.

On the berth or protective deck, forward, are store rooms, the dispensary, operating room, and sick bay; also crew's space, prison, band room, and quarters for machinists and petty officers. Abaft the forward turret, on the port side, is a refrigerating plant and ice machine, as described elsewhere; on the starboard side a laundry, and, at the conning-tower tube a printer's room. Abaft this for about 120 feet are coal bunkers on each side, separated from the boiler hatches by fore-and-aft passages; at the after end of boiler hatches is the evaporator room. The rest of this deck, to the after turret, is taken up by junior and warrant officers' state rooms and dining room, and abaft the after turret is the ward room. The total complement of officers and crew will be about 800 men.

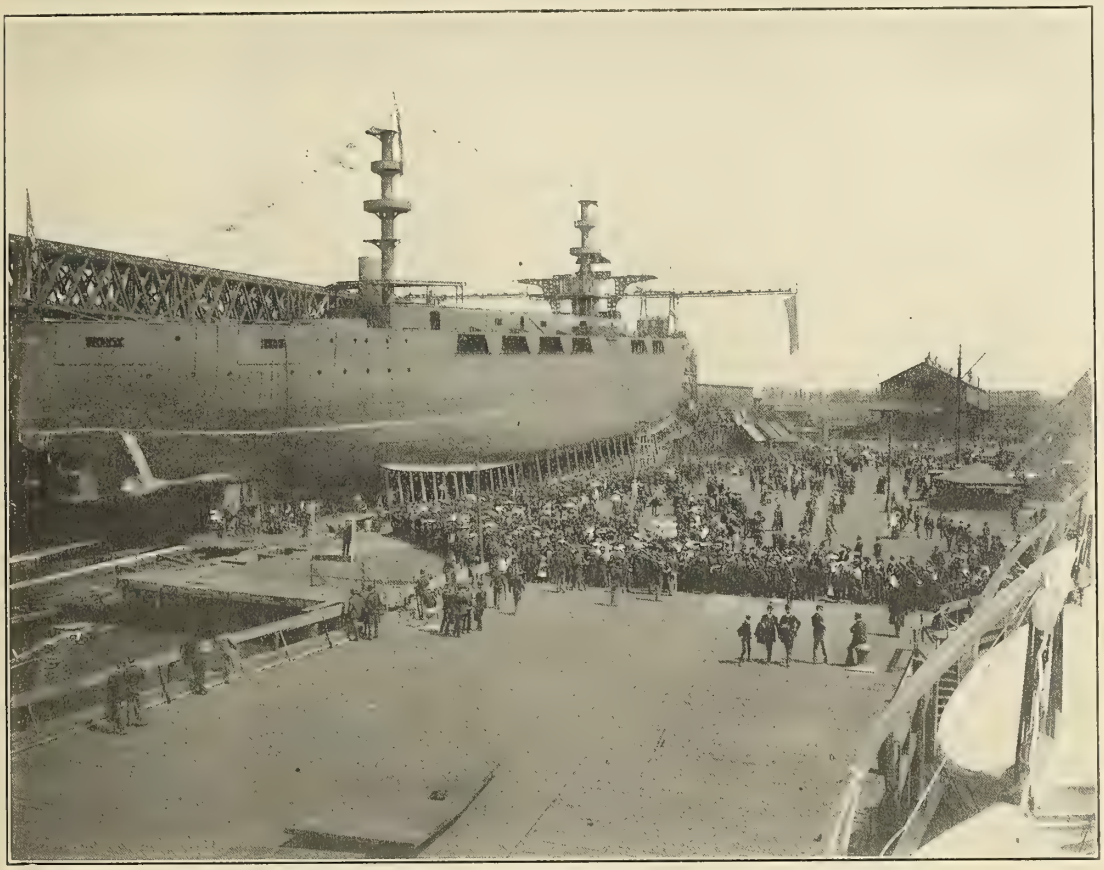
Below the protective deck, as previously stated, are the magazines, shell rooms, ammunition handling rooms, and passages, coal bunkers, machinery space, and various store rooms.

DRAINAGE.

There is a very complete drainage system for salt and fresh water and also flooding pipes for magazine, shell rooms, and trimming tanks. The main drain proper, a 15 1-2-inch galvanized steel pipe, runs from the forward boiler rooms to the engine room with a valve in each machinery compartment. The main circulating pumps and all the principal steam pumps connect to this pipe. There is a 5 1-2-inch auxiliary drain pipe, connecting manifolds forward and aft, from which manifolds pipes lead to all the compartments to be drained; the auxiliary drain also connects to the main drain and to all steam pumps available for drainage. The valves in main and auxiliary drain pipes are worked from their own compartments and from the deck above.

MAIN ENGINES.

The installation of propelling machinery proper occupies a space 108 feet long and 50 feet wide, for the boiler rooms, and 44 feet long and 52 feet wide for the engine rooms. There is a fore-and-aft bulkhead extending the whole length of the machinery space and athwartship bulkheads, dividing the total space into eight watertight compartments, six for the boilers and two for the



NEWPORT NEWS SHIPBUILDING AND DRY-DOCK COMPANY, ON APRIL 5, 1904.

engines. The main propelling engines are right and left, one in each of the after machinery compartments. They are of the vertical, inverted, direct-acting, triple-expansion type, each with a high-pressure cylinder 35 inches diameter, an intermediate-pressure cylinder 57 inches diameter, and two low-pressure cylinders 66 inches diameter. They have a common stroke of 48 inches and are designed for a combined I. H. P. of 19,000, the piston speed, at 120 revolutions per minute, being 960 feet.

The cylinders are of cast iron, all cylinders and valve chests having working liners, and great care is taken to keep the cylinder volumetric clearances as small as possible. The clearances between pistons and cylinder heads are 1-2 inch at top and 3-4 inch at bottom. All cylinders are jacketed, steam for the jackets being taken from the main steam. The stern tube and propeller shafts are 17 1-2 inches diameter with 10 1-2 inch holes. The inboard coupling is the usual removable type, so that the shaft may be drawn out aft, through the stern tube, and there is an outboard sleeve coupling covered by a casing filled with tallow.

The bed plates, of cast steel, are in I section with fore-and-aft and athwartship girders, the latter forming seats for the main bearings. The bed plates are secured to the keelsons by body-bound steel bolts fitted with horse-shoe washers. The engine framing is of the usual, open, Bureau design, formed of steel columns and trussed by stays.

The propellers, turning inboard from above, allow the crossheads to be on the outboard side, thus bringing the working platform inboard, the most convenient location for the engineer. The thrust bearings are of the usual horse-shoe pattern with a steady bearing at each end.

The pistons are of cast steel, dished, the rods 8 inches diameter being of forged steel and hollow. The connecting rods are 96 inches between centers, four cranks long, 8 1-2 and 9 inches diameter and hollow.

The piston rod passes through the crosshead and is secured by a nut on lower end. The crosshead pins are 10 inches diameter and 10 1-2 inches long with axial holes. They are flattened 3-8 inch on each side, the flats stopping short 1 1-2 inches from ends of pins to prevent the escape of oil. The slippers are bolted to the outboard side of the crossheads. They are of cast steel, being faced on front, back, and sides with white metal 1-2 inch thick, dovetailed into recesses and hammered into shape. The ahead sliding surface is 30 by 23 inches and the total backing surface 30 by 17 inches. The crosshead guides are of cast iron, of the slipper type, hollow for the circulation of water to keep them cool, and the bearing surfaces are grooved for oil. The ahead guides are securely bolted at bottom to cast-steel strong backs of I section, which latter are secured to the outboard columns; at top the guides are bolted to the cylinders. The backing guides are bolted to flanges on the ahead guides, with tin liners between to take up wear.

The valve gear is of Stephenson type, with double bar links, and all valves are worked direct; the main cut-off is full gear, for both ends, being about .73 of the stroke.

ENGINE-ROOM AUXILIARIES.

There is one condenser on the outboard side of each engine room. The shells are of boiler plate, 7 feet inside diameter, 3-8 inches thick, and 12 feet 10 inches long between tube sheets. There are 5,684 tubes 5-8 inch outside diameter No. 18 B. W. G., and the total cooling surface for each condenser is 11,969 square feet, being 1 1-4 square foot per I. H. P. of the main engine.

There is one double, vertical-beam air pump for each engine, with two steam cylinders 14 inches diameter, two air cylinders 32 inches diameter and stroke 21 inches.

For each main condenser there is a 45-inch diameter runner, centrifugal, double inlet, circulating pump, driven by a compound engine 11 and 22 inches by 10 inches stroke, with cranks at 90 degrees. Each pump is capable of discharging 12,000 gallons of water per minute from the bilge when making 266 revolutions per minute. Each draws from the main drain, the engine-room bilge, and the sea, and discharges into the condenser or overboard. There is a valve in each suction pipe which is so connected by a locking device to the valves mentioned above that when one is open the others must be closed; there is also a safety sluice valve inboard of the sea valve.

In each engine room there are two main feed pumps, capable of delivering 400 gallons per minute each, and in each boiler room an auxiliary feed pump of 260 gallons capacity. In addition there is a 400 gallon fire and bilge pump in each engine room, a hot well pump of 800 gallons, which draws from the air-pump suction pipe and discharges into the feed heaters, and a sanitary and bilge pump worked from each main shaft.

In each engine room there is an auxiliary condenser with combined, horizontal, double-acting, air and circulating pump. Each has a cooling surface of 600 square feet and is connected to all the auxiliary machinery through the auxiliary exhaust pipe. There is, also, in the dynamo room, an auxiliary condenser of 1,200 square feet cooling surface for the exclusive use of the dynamo engines.

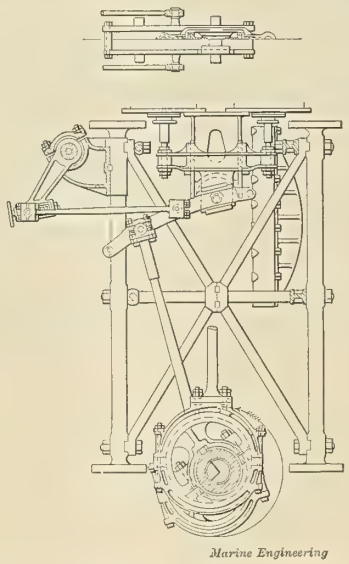
A feed heater of 950 square feet heating surface is placed in each engine room, steam being taken from the auxiliary exhaust pipe. The main feed pumps discharge through the heaters and there is a by-pass for cutting off the heater when not in use.

There is a combined feed and filter tank in each engine room, underneath the condenser, of a total capacity of 4,800 gallons. The tanks are of 1-4-inch galvanized steel, well braced internally, and having openings in the filter chamber for the discharges from the main and auxiliary air pumps, hot well pump, and an overflow pipe, drain pipes, etc. The outlet to feed and hot well pump suctions is controlled by a balanced float valve.

BOILERS.

Forward of the engine room is a 12-foot coal bunker through which, on each side of the center line bulkhead, a 4-foot passage gives communication between the engine and boiler compartments and affords space for running pipes, etc. Forward of this athwartship bunker are the six boiler compartments, three on each side of the ship, flanked on their outboard sides by coal bunkers, as shown the sections on page 251. In each of these six compartments are placed four water-tube boilers, with tubes running fore and aft. These boilers are of the usual Niclausse type, the outboard boilers having 15 elements, the inboard 16 elements each, and each boiler has three furnace doors. The total grate surface is 1,280 square feet and the total heating surface about 57,000 square feet. The grates are 6 feet 9 inches long and the tubes 7 feet 5 3-4 inches long. The boiler drums are 42 inches diameter.

As the indicated horse power, on trial, of the auxiliary machinery on large battleships is about 4 per cent. that of the main engines, the boilers here are required to develop a total of about 15 1-2 I. H. P. per square foot of grate.

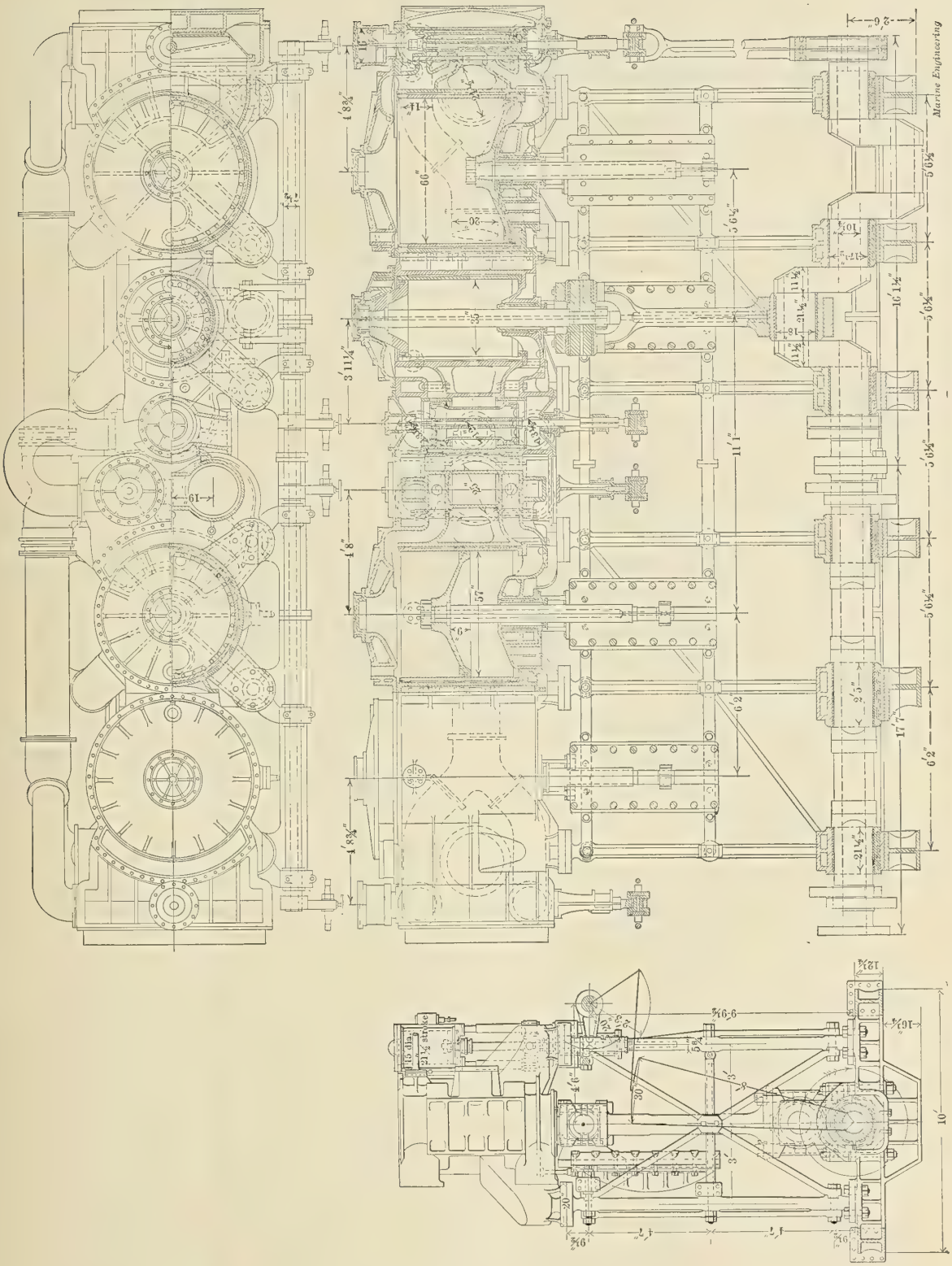


VALVE GEAR AND FRAMING. PORT ENGINE, LOOKING AFT.

The closed fire-room system of forced draft is used, the necessary air being supplied to each compartment by two steam-driven blowers, 42-inches diameter, and of sufficient capacity to maintain an average air pressure in the ash pits of 1 inch of water at not more than 500 revolutions per minute. The coal bunkers are arranged with reference to the rapid and efficient supply of coal to the fire rooms and have a normal capacity of 900 tons.

One of the noticeable features in this ship is the large capacity of the evaporating and distilling plant, being respectively 19,000 gallons and 10,000 gallons of water per 24 hours. There are four evaporators of 240 square feet heating surface each and three distillers. The evaporators are arranged to work in pairs, double effect. The following pumps are run in connection with the plant: distiller circulating pump (also used for flushing purposes), feed pump, brine pump, and fresh-water pump.

There is a very complete heating plant for heating all the living quarters of the ship, as well as water for bath tubs, shower baths, etc.



TRIPLE EXPANSION, FOUR CYLINDER ENGINE OF THE UNITED STATES BATTLESHIP VIRGINIA, PORT ENGINE.

H. P. CYLINDER, LOOKING FORWARD.

The refrigerating plant is of large capacity, including an ice machine capable of producing the cooling effect of three tons of ice per day. There is also a very complete work shop, with lathes, shaper, drill press, sensitive drill, milling machine, punch and shears, emery grinder, grindstone, and vise, benches, etc., all driven by an electric motor; there is also a blacksmith's forge, with all the necessary tools and fixtures.

The general tools and outfit for the ship, supplied by the contractors, include wrenches for all size nuts, tube expanders, any special tools used for the boilers, trammels and gages, hydraulic jack, fire tools for each fire room, coal and ash buckets, etc., and, in addition, when the ship goes into commission, about 40 tons of engineer's stores, including all tools necessary, will be furnished her by the government. There is also a very complete outfit of spare parts supplied by the contractor, and this includes all the important parts of the main or auxiliary machinery likely to break down.

The boilers, each length of pipe, every casting, and, in general, every item used in the machinery installation, is tested before being placed on board.

There is a fire main on each side of the ship through the machinery space and below the protective deck. From this main vertical risers pass up the hatches where required and end in hose connections for the attachment of fire hose or connections for washing decks. All couplings are for the 2 1-2-inch standard navy hose.

There is a very complete ventilating system. Unlike preceding ships, in which the ventilation was provided by a small number of large blowers, located in blower rooms, the *Virginia* has no less than thirty-five ventilating blowers located in various parts of the ship, but mostly on the berth deck, and varying from 1-2 to 6 horse power each, the total horse power being about 75. These blowers are all electric and the air supplied is led to the proper compartments through ducts of ample size. There is steam steering gear and windlass, also two hand-power capstans. On the main deck forward are three cranes for the anchors. On top of the superstructure, which encloses the space between the turrets on this deck, are four boat cranes for swinging the boats into position; there are also davits for harbor use, and all davits are arranged to turn down. The following boats are carried: one 16-foot and two 20-foot dinghys, four 30-foot cutters, one 30-foot barge, one 30-foot gig whaleboat, two 30-foot whaleboats, two 36-foot launches, one 36-foot steam cutter, one 50-foot steam cutter.

ENGINE DATA U. S. BATTLESHIP VIRGINIA.

	H. P.	I. P.	1 and 2 L. P.
Diameter cylinders..	35 ins.	57 ins.	66 ins.
Stroke	48 "	48 "	48 "
Piston rods, diameter	8 "	8 "	8 "
Hole, diameter	1 1-2 ins.	3 5-8 ins.	5 "
Lineal clearance, top	1-2 in.	1-2 in.	1-2 in.
" " bottom.	3-4 "	3-4 "	3-4 "
Port area	165 sq. ins.	355 sq ins.	425 sq. ins.
Thickness cylinder walls.	2 ins.	1 1-2 "	1 1-2 "
" liners	1 1-2 ins.	1 3 8 "	1 1-4 "
" cyl. covers.	1 1-2 "	1 3-8 "	1 1-8 "
Con. rod L bet. centers	8 ft.	*	*
" " diam., top	7 3-4 ins.	.....	....
" " " bottom	9 ins.	.....	....
" " hole	1 1-2 ins.	4 1-2 ins.	5 ins
Crosshead pin, diameter..	10 ins.	.....	....
" " L	10 1 2 ins.	.....	....
" surface ahead..	30 x 23 ins.	.....	....
" " backing.	30 x 17 "	.....	....
Crank pin, diam	18 ins.	.....	....
" " " hole	10 1-2 ins.	.....	....
" " " length	21 1-2 "	.....	....
Thickness of crank webs..	11 1-2 "	.....	....
Lth. journal bearings	21 1-2 "	.....	....
Crank shaft, diam	17 1-2 "	.....	....
" " hole, diam..	10 1-4 "	.....	
Couplings, diameter	32 ins.	.....	
" thickness. .	3 3 4 ins.		....
Steam pipe, diameter	12 ins.	(2) 13 1-2 ins.	(2) 14 ins.
Revers. shaft, "	7 1-2 ins.	.....	....
Throw of eccentric	9 ins.	.....	....
Valve stem, diameter	3 "	3 1-2 ins.	3 1-2 ins.
Piston valves, "	20 "	(2) 22 ins.	Slide.

* Where dimensions are not given, same as H. P.

MARINE ENGINEERING DATA CARD. **JUNE, 1904.**

NAME—Virginia. NATIONALITY—American. TYPE—Battleship.

LAUNCHED—1904. BUILDERS—Newport News S. & D. D. Co. OWNERS—U. S. Navy.

Length on load water line .....435 ft. 0 ins.
Beam, extreme..... 76 " 2 1-2 "
Draft, mean, normal load ..... 23 " 9 "
Displacement, " " ....14,948 tons
Normal coal supply..... 900 tons
Maximum coal supply in bunkers.....1,704 "
Steaming radius, 10 knots .....3,825 miles
Speed trial.....19 knots

Batteries:
Main, 4 12-in. B. L. R., 8 8-in. B. L. R., 12 6-in. R. F. G.
Secondary, 12 3-in. R. F. G., 12 3-pd., 8 1-pd., 2 3-in. field, 8 machine.
Torpedo tubes ..... 2 submerged

Armor:
Water line belt 8 ft. deep, amidships top 11 ins, bottom 8 ins., tapering to 4 ins. at ends
Casemates..... ....6 ins.
Turrets.....12 ins. to 8 ins., 6 1-2 ins. to 6 "
Barbettes .10 " " 1-2 ins., 6 " " 4 "
Protective deck.....3 ins. to 1 1-2 "

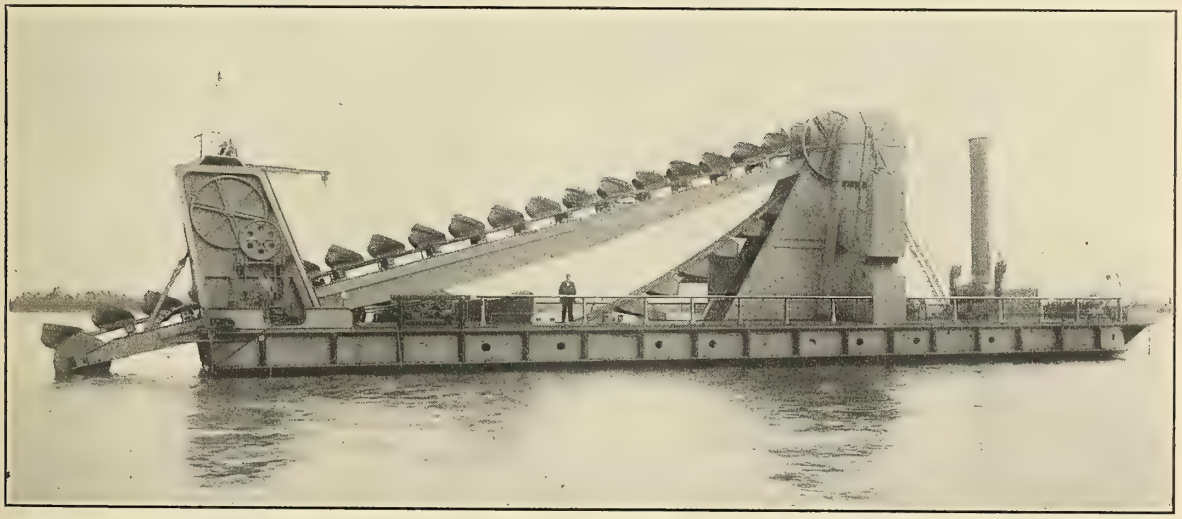
Engines.....2 sets, 4-cylinder triple
Cylinder diameters .....35, 57, 66, 66 ins.
Stroke.....48 "
Valves .....piston
Framing.....open, columns and bracing
I. H. P., designed.....19,000
R. M. P..... 120
Cooling surface, 2 condensers .....23,938 sq. ft.

Boilers: Type.....Niclausse
Number 24
G. S..... 1,280 sq ft.
H. S.....57,000 " "
Draft .....Forced closed hold

ELECTRIC LIGHTING AND POWER PLANT.

The increasing variety of uses to which electricity is applied on shipboard has led to much larger electric plants than were formerly installed. The vessel will be lighted throughout by electricity. The electric plant will consist of six 50-Kw. and two 100-Kw. steam-

driven, direct-connected generating sets, all to be of 125 volts pressure at the terminals, engines to work at 150 pounds steam pressure. The plant is located in an upper and lower dynamo room, just forward of the forward fire room bulkhead and below the protective deck. There will be about 1,030 electric fixtures, complete, with necessary incandescent lamps and outlets, 10 inclosed arc lamps in engine and fire rooms, 6 search lights mounted on platforms or bridges, as directed, 2 sets of electric night-signaling apparatus, 2 diving lamps with 150 candle-power incandescent lamps, 2 truck lights, 6 portable electric ventilating sets of 1-4 horse power, 40 1-12 horse-power desk and bracket fans, 6 1-6 horse-power bracket fans, 1 electric whistle operator, switchboards, main distribution boards, together with the necessary wire, fixtures, lamps; also instruments, tools, spare parts and stores usually furnished for the proper manipulation of such a plant. There will be the usual means of interior communication, such as telephones, voice pipes, call bells, gongs and annunciators, engine and steering telegraphs, revolution and rudder indicators, heeling indicators, automatic fire alarms, warning signals, etc.



BUCKET DREDGER OF 860 TONS CAPACITY PER HOUR, BUILT IN BELGIUM FOR AN ENGLISH COMPANY.

The Stationary Bucket Dredger Marquess.

The plate shown above is of a dredger built by the firm of A. F. Smulders, of Rotterdam, for the Cardiff Railway Company, and is of special interest, as its output reaches about 860 tons per hour.

The hull is entirely built of mild steel, according to Lloyd's highest rating for this class of vessel, and is 136 feet 3 inches long, 24 feet 7 1-4 inches wide, by 10 feet depth at the side. The thickness of bottom plates for one-half length amidships is 7-20 inch, and at ends 6-20 inch; that of side plates for one-half length amidship is 13-14 inch, and at ends 11-40 inch. The hull is provided with the necessary cabins for first and second dredging master, engineer, firemen and sailors; its after part is provided with a trimming tank, which can be used as water tank for boiler feeding when necessary. The main engine is of the horizontal compound system, with surface condenser and reversing gear. The air and circulating pumps are driven by the lengthened piston rods of the high and low pressure cylinders. The air pump is single-acting and vertical, the circulation pump horizontal and double-acting. The cooling surface of the condenser is of about 338 square feet. The tubes are of brass tinned out and inside, and fixed in the brass tube plates by yellow metal nuts. The engine is provided with a feed pump driven from the air pump crosshead. The boiler is of the usual cylindrical marine type, built of mild Siemens-Martin steel, with two furnaces. For feeding boiler, there is a donkey pump and an injector. The pump is equally arranged for deckwash and for bilge pumping.

The dredge is provided with five steam winches and two hand winches. The steam winches are: the ladder winch, two foreside chain winches, one bow chain winch, and one after chain winch. Hand winches are for raising and lowering the movable parts of the shoots. All steam winches have two cylinders. The ladder winch works with worm and worm-wheel on two pairs of cast steel spurwheels. The larger spur is keyed on the steel shaft of the cable drum, on which the steel wire ropes are wound. This winch is provided with reversing gear. The foreside chain winches are coupled in and out by friction clutches, the drums are provided with screw brakes. The bow chain winch is of the same construction as the side winches, but is stronger, has no screw brake, but rack and pinion wheel. This winch is so constructed that the paying out of chain takes place at single gearing and hauls in at double gearing. The after winch is of the same construction and dimensions as the foreside winches, excepted, that the shaft is provided with three drums, which can work all together, or each separately, as necessary.

The buckets, of a capacity of about 19 cubic feet and of eliptical form, are entirely built of mild steel, provided with strong cutting knives of Dalzell steel. The bushes and pins are of Hadfield's maganese special steel; the pins with square heads. The links are made in Dalzell steel and all bushed with the above-named manganese. The outside intermediate links are provided with noses. The upper tumbler is four-sided,

made in one steel casting, with the shaft hydraulicly pressed on and keyed afterwards. The lower tumbler is in two halves of cast iron pressed and keyed on to steel shaft. The corners of the tumbler are protected against wearing by hardened steel corner plates, and fixed on six steel corner plates. These plates are fixed on the body of each half tumbler. The top tumbler is placed at about 27 feet above the water line.

The shoots are made of Siemens-Martin steel, and are provided with wearing plates. They are placed at an angle of 30 degrees, so that the materials may be discharged on both sides of the dredger. A turnover trap for changing the direction of discharging, working from deck, is provided. The shoots are provided with two movable parts, which can be lowered or raised by the two hand winches named above.

Power is transmitted from two pulleys on the engine shaft to two similar pulleys on the upper tumbler shaft through two camelshair belts. The transmission shaft has two cast steel pinions, working on two cast steel bever geared wheels, whereof one is keyed on each side of the upper tumbler. The transmission is so arranged that every minute from 14 to 16 buckets pass the upper tumbler. The advantage of the belt transmission is that it forms a natural friction safety device, which will always do its duty when the buckets are unexpectedly overloaded with large stones, trunks of trees, etc. The main framing is made of steel plates. It is of the tubular form, and so constructed that it can be lowered to deck level. The forelegs are riveted to the sides of the well and are supported by the strengthened floors on the bottom on each side of the well. The afterlegs are supported by a strong girder, also of box form and riveted to the deck. This girder is carried on two legs, riveted to the sides of the hull. On both sides and at the after side, the main framing is sheeted with steel plates. The ladder frame is constructed in an extra strong manner of plates and angles, and on the top it is provided with a small crane of 1 1-2 tons capacity.

The wire rope drum is of cast iron. The ladder has a length of about 88 feet 6 inches, is constructed as lattice girder of steel plates and angles well strengthened by traverse girders and crossbeams. It is provided with rollers of chilled cast iron on steel axles. The axles turn in cast iron bearings protected against mud and sand.

The boat is lighted electrically by means of a direct current dynamo, capable of supplying 1,600 candle power to lamps for lighting deck, engine room, stokehold, etc.

Government Shipbuilding for 1904 and 1905.

The session of Congress recently closed will not be remarkable for its liberality in appropriations for the construction of new vessels for the government, except that it made quite a liberal appropriation for new naval vessels. The following are the detailed amounts appropriated for the fiscal year beginning July 1, 1904, so far as they interest shipbuilders:

For one first-class battleship, to carry the heaviest armor and armament, and to have a displacement of 16,000 tons, at a cost not to exceed $4,400,000, exclusive of armor and armament.

For two first-class armored cruisers, of not more than 14,500 tons displacement, not to cost more than $4,400,000 each, exclusive of armor and armament.

For three scout cruisers, of not more than 3,750 tons trial displacement, to have the highest speed compatible with good cruising qualities and great radius of action, at a cost not to exceed (exclusive of armament) $1,800,000 each.

For two colliers, capable of accompanying the battle fleet, to have a capacity of carrying 5,000 tons of cargo coal, at a trial speed of not less than 16 knots, the sum of $1,250,000 each is appropriated, with the proviso that they shall be built in navy yards, one on the Atlantic and one on the Pacific coast, to be designated by the Secretary of the Navy.

For constructing sub-surface or sub-marine torpedo boats the sum of $850,000 is appropriated, the type or types to be selected by the Secretary of the Navy after a board has given the several types presentd a thorough competitive test.

The total amount appropriated for the naval establishment, to be used for the further increase, will therefore be $21,950,000.

For the other maritime branches of the government the appropriations were very meager. Bills for the construction of a derelict destroyer, several revenue cutters, and a number of light vessels and tenders failed of enactment, although they were all passed by the Senate. The following were authorized in the sundry civil bill.

For the purchase or construction of a boarding tug, for the use of the immigration service in New York harbor, $75,000.

For a lighthouse tender, for the fourth lighthouse district, to replace the *Zizania,* $125,000.

For a lighthouse tender, for the sixth lighthouse district, to replace the *Wistaria,* $130,000.

For a new lighthouse tender for Lake Superior the sum of $400,000 is authorized.

For the expenses of transferring two light vessels for the Pacific coast, now being constructed in New York and New Jersey to San Francisco, the sum of $20,000 is made available.

It is quite probable that one or more of the three new scout cruisers authorized by this congress will be fitted with turbine engines, as the Bureau of Steam Engineering has been working on plans for the same, in anticipation of the passage of the bill.

Lumber Rafts in the Pacific.

With the advance of civilization westward the center of logging interests has also moved to the west. A hundred years ago it was in Maine; fifty years ago it was in the middle west; and twenty-five years ago Wisconsin and Michigan were supplying half the lumber of the country. Recently the forests of the northwest Lake region have become denuded to such an extent that the greatest amount of lumber is now being cut from the states of California, Washington, and Oregon. It is estimated that they contain over eight hundred billion feet of uncut timber. Enormous as this figure is, it is stated that at the present rate of cutting only ninety years will elapse before these forests are exhausted.

A writer of the *World's Work* for February describes and illustrates the modern method of "Lumbering by

THE EMPTY CRADLE FOR BUILDING A GREAT RAFT—ON THE COLUMBIA RIVER, NEAR ASTORIA.

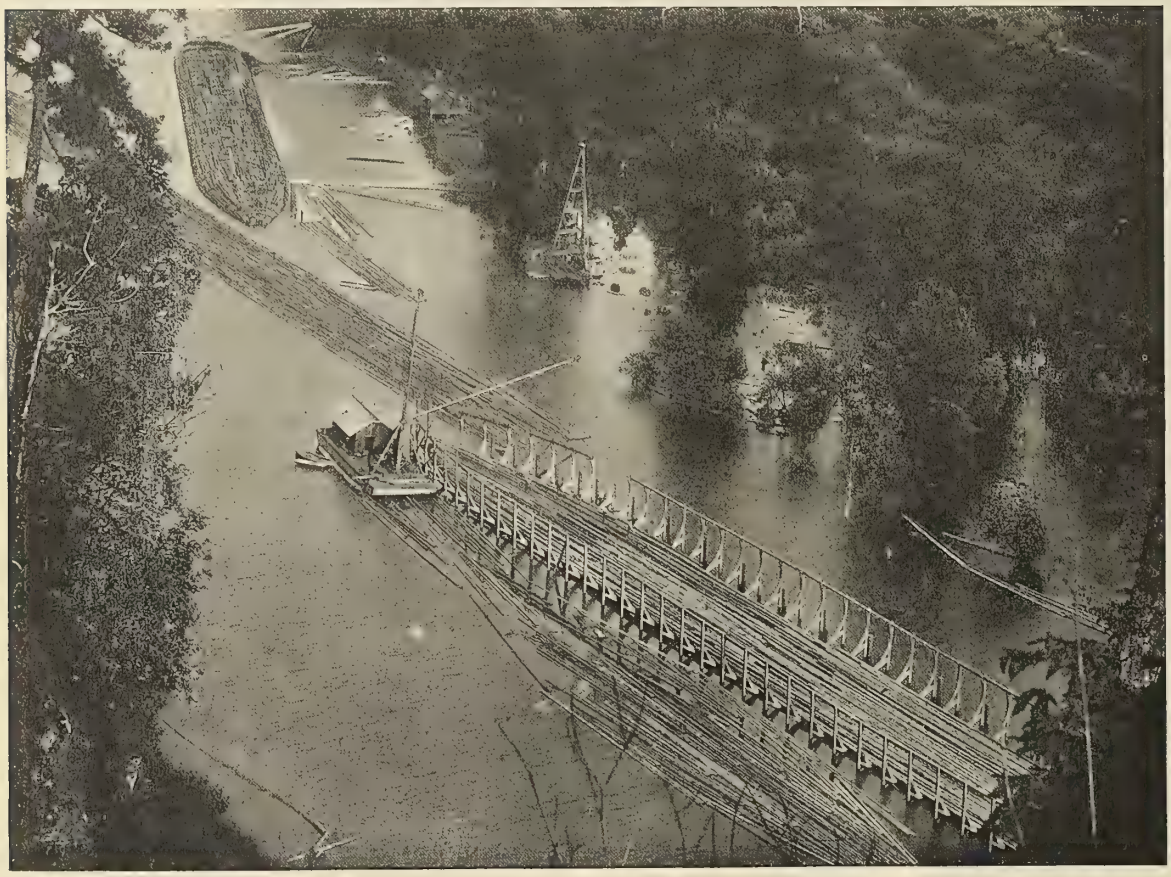
A GIANT RAFT ON THE COLUMBIA RIVER, BOUND FOR SAN FRANCISCO.

[Photographs from World's Work.]

Machinery" in the northwest. The operations in western timber camps are conducted on a gigantic scale; one company alone owns one million acres of heavily-timbered land, employs about 500 men, uses 75 horses, 20 donkey engines, and has built nearly 100 miles of railway. The work of the logging camp is systematized as nicely as that of a factory, and work continues throughout the year, except in specially inclement weather. The trees which are to be cut are marked and the direction in which they are to fall are decided by experienced men. The first cut is made from 6 to 8 feet from the ground with a cross-cut saw handled by two men, termed fellers, who stand on an improvised platform. This cut is made on the side of the fall at right angles to the line of direction and about one-third through the trunk. The undercut is then made with axes, and then the fellers begin sawing from the opposite side. When the cut is made wedges are driven in to guide the fall, and so experienced are the men that a tree may be sent to the ground within a very few inches of the position decided upon.

The next gang of men are called the buckers, who cut the tree into logs. These are followed by the barkers, who remove the bark from the side on which the logs are to be hauled. This is necessary as the bark is stout and rough and hinders the movements of the log. Swampers clear away the underbrush and make a passage for the logs, and the hook tender then takes charge and fastens to the log a heavy chain attached to a cable. This cable, which is from five to three thousand feet long, leads through several open sheaves to a donkey engine which pulls the log to the loading skids alongside the railroad track or to the river bank.

The coast fir trees are especially desirable for masts. The United States Navy Department recommends the use of fir on war vessels for all wood purposes except decorative interiors, and it is stated the flags of Windsor castle and that of the Japanese emperor fly from Oregon fir poles. The masts and spars on the racing yachts for King Edward and Emperor William were shipped from Puget sound. These trees are splendid specimens, perfectly straight, and ofttimes attain a height of 300 feet.



VIEWS ON ONE OF THE TRIBUTARIES OF THE COLUMBIA, SHOWING A FINISHED RAFT, A CRADLE BEING FILLED, AND A RAFT OF LOOSE LOGS TO GO INTO THE CRADLE.

Of late rafting the logs down the coast to San Francisco has become quite general. A cradle, with one side removable, is built as shown on page 259, and floated in the river between rows of pilings. It is then filled with loose logs by means of derricks and the logs are securely bound together with many heavy chains, and in some rafts there is as much as 100 tons of chains used. When the raft is completed one side of the cradle is pulled away and the raft is floated out. It is then ready for the tow boats which tow it to its destination.

Electric-Lighting Outfit for Launches.

BY D. A. RICHARDSON.

For large launches or houseboats undoubtedly the finest electric light outfit is a gasoline or steam driven direct connected set, but for the small and medium sized launch a compact enclosed generator, belted to the flywheel of the engine, is the most practical method of obtaining electric lights. The storage battery will be found an essential of such a plant, storing up as it does when the engine is running electricity enough for several hours of light.

There are three systems of protecting the battery, generators and lighting circuit. The most common is the circuit breaker, but it is used mostly on larger plants and is expensive; the second one is the fuse system, which is simple and easily handled, and adds to the appearance of a small switchboard, while the third system is the automatic switch, which is all right for very small outfits, but is liable to the troubles of all delicate automatic apparatus and is not suitable for large outfits where much current is used.

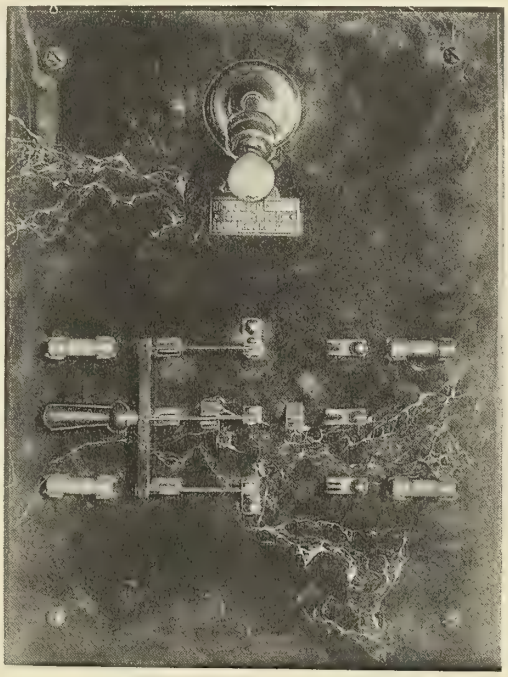
ELECTRIC GENERATOR DRIVEN BY BELT FROM MAIN ENGINE.

SWITCHBOARD.

The switchboard should be simple, easy to understand and to handle, and so far as possible, especially for small outfits where no regulation or meters are used, it should be so arranged that everything is accomplished by the manipulation of one switch. A medium-sized plant should have a switchboard with rheostat, for regulating the voltage, meters for intelligent and successful control and proper circuit and control switches. The control switches should allow the amperes to be read as well as the voltage of the battery, generator and light circuits, at will. In the small outfits the brightness of the pilot light on the switchboard, together with the amount of gassing of the battery, is near enough indication of the full charge. A new cheap indicator is being tested out, and will soon appear on the market for use on small switchboards, which will show at a glance the extent to which the battery is charged. This instrument will answer almost as well as meters, and is much easier for a person not familiar with electricity.

With the fuse system everything is well protected, and the new enclosed arc fuses give absolute protection from explosion, there being no visible flash when the fuse breaks. The fuses should be easily removable, and so arranged as to protect the generator by burning out if the operator forgets to throw over the switch before shutting down his engine. This prevents the battery from burning out the generator. Also the circuit running to the lights should be fused to prevent running the batteries down should a short circuit occur along this line.

The switchboard should also provide for the regulation of the lights so that the lamps are not burned out when charging the batteries. This light regulation should be accomplished with the main switch which puts the batteries on charge, so that the operator has no reason to think of this point or be obliged to look out for it.



SWITCHBOARD SUITABLE FOR SMALL SET.

Every switchboard should be neat in appearance and of slate or marble, that the switches may be well insulated and remain where placed. The switches should be ample for the lights to be carried and of a thoroughly substantial type.

GENERATOR.

The generator should be fully enclosed, or nearly so, and as waterproof as possible, all leads being inside. It should be of ample size for the work, and have rectangular carbon brushes. A cheap generator is the poorest investment for boat work. It should be built for marine work, and with proper insulation for the same. Proper provision should be made for adequate lubrication and ring oiled bearings are preferable for medium-sized outfits.

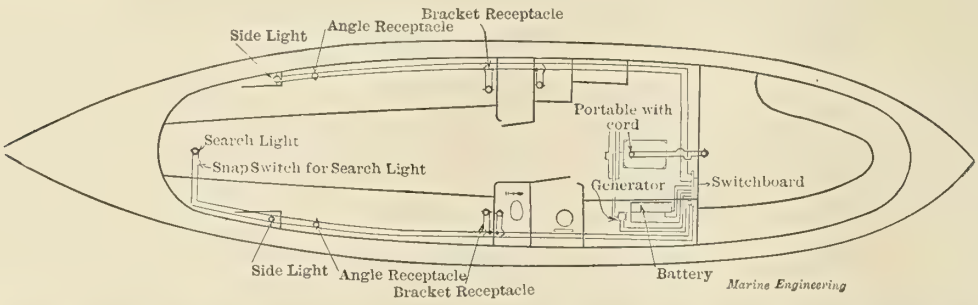
STORAGE BATTERY.

The storage batteries for a successful outfit should be placed in strong jars, preferably of rubber, and assembled in special cases, so that the jars are not crowded and are thoroughly sealed with covers at the tops to prevent leakage of any electrolyte into the bottom of the cases. The plates should fit the rubber jars very carefully, in order to prevent any movement of the plates; at the same time allowance should be made for the swell-

ing of the plates without breaking the jars. The covers should be easily removable for inspection, and should be placed a little below the top of the jar, to prevent any liquid which might get on the top of the cover, from spilling out. The cover should have vented plugs. The plates should be arranged two to each cell, a positive and a negative being connected together, thus facilitating inspection of the plates, for by merley pulling up on the connecting strap the two plates can be looked over and easily and quickly returned. A cheap storage battery is a poor investment.

Strict attention to the above details will add materially to the life of the battery. Little care will be needed in the average use of the storage battery each season other than filling each cell with water to the proper height every two weeks or so. In the winter it would be wise to leave the batteries with some competent electrician to be taken care of and to be delivered in the spring with the electrolyte the right strength, everything cleaned out, and ready for another season, yet by carefully following the directions accompanying each battery it is perfectly possible for any one to dispense with outside assistance. The instructions show how the battery may be emptied in the fall, and remain dry during the winter, being filled up in the spring with electrolyte, and be ready for business as usual. In designing a launch-lighting outfit care should be taken that there are neither too many nor too few cells for the special work required. If too many are used, the number will be an additional burden of caretaking; if too few are used, the fact will be readily seen upon the life of the lamps; therefore the wisdom of purchasing outfits that are put out by a competent engineer or people who have had long experience in the line or work.

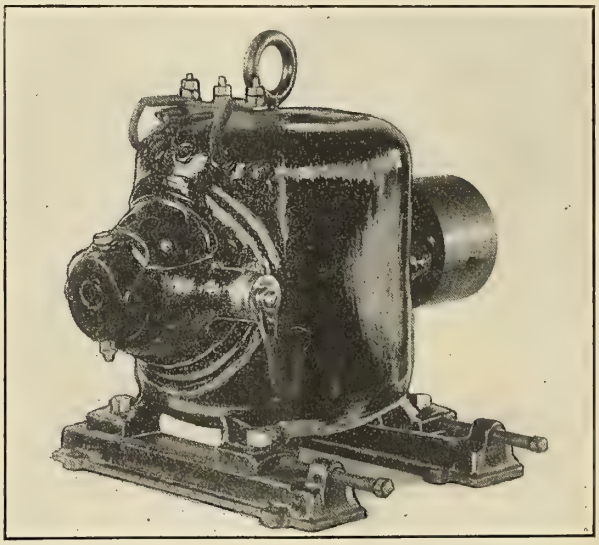
The storage battery is essentially a complete lighting plant, whether on a boat or on the shore. This is proven by the fact that large steam yachts have their own storage battery plants and that a great many town lighting systems have storage battery plants as auxiliaries. It is even more essential to have a storage battery on a small launch than on a yacht, especially where the current used to light the lamps is taken from the flywheel of the engine, as it enables one to have light without running the engine. There is another fact which enters materially into the advantage of storage batteries, namely, the steadiness of the light, even when using the lights while running the engine and charging the batteries. This point will be very noticeable, as the storage battery, properly connected up, will prevent lamps from burning out, and will supply a uniform current with light free from pulsations. The storage battery also furnishes ample current for ignition at all times for starting the engine and for regular running, thus doing away with extra dry cells, magneto and other apparatus. The only disadvantages of the storage battery are their weight, extra space required and the slight attention which they need once a month and at times when the boat is laid up for the winter. A convenient and simple plan for wiring a launch is given below.



WIRING PLAN FOR LIGHTING A LAUNCH, SEARCHLIGHT, RUNNING LIGHTS, CABIN LIGHTS, STORAGE BATTERY, AND BELT-DRIVEN GENERATOR.

SEARCHLIGHTS.

The searchlight, although in many cases not an absolute necessity, is of great advantage on a launch or yacht of any size. The searchlight can be had of various powers. Some are arc lamps and some incandescent lamps. The arc lamp is necessarily from its construction more expensive, and has more mechanism to look out for.



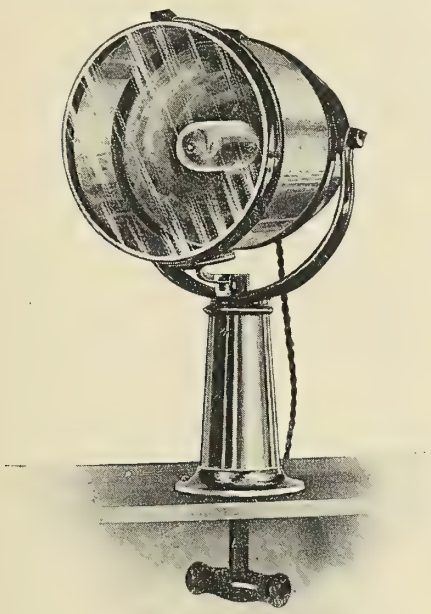
SMALL GENERATOR SUITABLE FOR DRIVING FROM MAIN ENGINE.

A new type of inexpensive incandescent searchlight, here illustrated, has just been put on the market. It is of polished brass, and is for pilot house control. It not

only costs much less than the arc lamp, but it is operated from a few storage batteries which are considered part of the lighting outfit, and is therefore available at all times. It has many advantages over the ascetylene lamp, in that there is no fire required, no carbide to clean out, gives a much steadier, cleaner light and continues the same for hours, and yet does not corrode the reflector. All that is required to light it is to snap a switch, same as with the cabin lamps.

The secret of the success with this incandescent searchlight lies in the special reflector used, coupled with a special searchlight incandescent lamp and peculiar method of placing same in the reflector. The pilot house control is the finest, one handle answering for both horizontal and vertical movements. According to the makers' figures, the range of this incandescent searchlight is over 200 to 500 feet, although much better results than this are being obtained right along.

The arc searchlights are run from the generator direct, and are very much higher candle power, and therefore, of course, longer range, being from 1-3 to 1-2 mile.



SEARCHLIGHT WITH INCANDESCENT LAMP.

The lamps for these outfits should be of best quality, especially for the low-voltage ones, and great care should be taken to see that they are right. There are some new double filament lamps used on complete outfits which give double the life of the old lamps; also a doorknob lamp with the silvered back is now made, which uses about 1-2 the energy with a better light.

The fixtures for the medium size launches should be plain style but substantial, and comprise a portable lamp with socket, side brackets and ceiling lights. The wiring of the boat should be very carefully followed, as it is most important. Because of the moisture, the wire used should be covered with very best quality rubber.

To sum up, a lighting outfit for a launch should have a storage battery, and should be complete in every detail, with a generator of the first quality as a matter of course, switchboard suitable for the size plant used, wire, fixtures, cleats, etc., all of the best design and material.

Finally, a word should be added concerning the cost of small lighting outfits. The simplest one can be bought for about $60. A very practical launch-lighting outfit, consisting of ten double filament lamps, generator, belt, 10 cells storage battery, switchboard with fuses, pilot light, etc., fixtures, wire, cleats, tape, etc., with full directions for installing and operating, can be had for $115, or for $150 including an 8-inch incandescent searchlight. An outfit for a 60-foot launch, consisting of the above but with a more elaborate switchboard, having meters, double the number of storage batteries and lamps and with a 12-inch incandescent searchlight can be had for $270, or with an arc searchlight for $340, or without searchlight, $215.

Trial of S. S. Nikko Maru.

Through the courtesy of the Mitsu Bishi Dockyard and Engine Works, Nagasaki, Japan, the following abstract of the official trial results of the steamship *Nikko Maru*, described in MARINE ENGINEERING of February, 1904, is given below.

The government surveyors and owners' representatives were present at the trial. The machinery ran with smoothness throughout. The boilers steamed well and remained perfectly tight. The ship and engines were completely satisfactory.

Length	420 feet 0 inches
Beam, molded	50 " 0 "
Depth	30 " 0 "
Draft, mean	15 " 6 1-2 ins.
Displacement, mean draft	5,405 tons
Block coefficient	.577
Area of midship section	729 sq. ft.
Midship section, coefficient	.94
ENGINE: Three-cylinder triple.	
Diameter cylinders	31, 51, and 85 ins.
Length of stroke	54 ins.
Working pressure	185 lbs.
PROPELLER: Diameter	17 ft. 9 ins.
Pitch	20 " 6 "
Number of blades	4
BOILERS: Number	2 double end; 2 single end
Diameter	15 ft. 6 ins.
Length	18 ft 0 ins.: 10 ft. 6 ins.
G. S., total	465 sq. ft.
H. S., total	14,840 sq. ft.
Cooling surface condenser	6,414 sq. ft.
Date of trial	December 10, 1903
Weather	fine
Sea	calm
Course	3.458 nautical miles
MEAN OF SIX RUNS OVER COURSE:	
Boiler pressure	185.6 lbs.
H. P. valve chest	172 lbs.
Vacuum	24.7 ins.
Revolutions	98.83
Speed	17.75 knots
Slip	11.23 per cent.
INDICATED HORSE POWER, TOTAL	6,693.8
H. P. cylinder	2,174.9
I. P. "	2,447.6
L. P. "	2,071.3

Electricity in the British Naval and Merchant Marine.

BY SYDNEY F. WALKER.

Electricity is making its way steadily in both His Majesty's naval service and in the much larger sphere of the British merchant marine. In the former service it has been very much handicapped until recently, owing to the peculiar organization of the Lords Commissioners of the Admiralty. As readers of Marine Engineering know, the navy of the United Kingdom is administered by a board consisting of a First Lord, who sits either in the House of Peers or in the Commons, and answers for the navy on all occasions; two Naval Lords, or Sea Lords, as they are usually called, who are naval officers of a certain distinction, but not always of the highest rank (on several Admiralty boards captains have had seats), and two Civil Lords, as they are termed. In addition there is a Secretary to the Navy, who also has a seat in the House of Commons and who answers for the navy where the First Lord happens to be in the Peers and for his chief on all occasions; and a whole staff of officials.

The engineering department is absolutely unrepresented on the board, though an eminent officer connected with that branch has an office at the Admiralty, just as the head of the medical branch has. Electricity is also, or was until within the last few months, unrepresented in any shape or form, either at the Admiralty or in the service at large. The only representative of electrical science carried in even the largest battleships was the torpedo lieutenant, who shared with the fleet engineer the responsibility for the working of all the electrical apparatus on board. Some of the smaller ships carried a torpedo gunner who was an electrical expert and had certain limited authority.

The division of responsibility between the engineering and torpedo staffs resulting from this arrangement was really ridiculous. Electricity has been used in His Majesty's navy for a great many years—twenty at least—for lighting all the large and a good many of the smaller ships, and for some ten years past it has been gradually used for power purposes; yet, until recently, there was no officer actually responsible for the proper working of the apparatus. The engineering staff looked after the engines and dynamos, but their charge ended at the terminals of the dynamos. At these points the torpedo officer took charge, and no alteration could be made in the connections at the switchboard without his permission, and generally without obtaining the key of the switchboard from him. Thus if, as it often happened, the engineer on watch found it necessary to stop one of the engines and dynamos and connect another set, he could not do so, no matter how pressing might be the necessity unless the torpedo officer had given his permission to do so, and had unlocked the switchboard locker.

THE METHOD OF WORKING GENERATING SETS IN H. M. NAVY.

The method of working lighting and power plants in His Majesty's navy has been on what is termed on this side the independent system, in which each engine and dynamo is run separately and takes its share of the load separately, without reference to the others. The method was probably best suited to the conditions all things considered. Where two or more machines are running together, if they are connected in parallel there is always the possibility of a difference of speed or armature resistance between the dynamos, and the result is that that dynamo which is running at the lower voltage cannot deliver current at all to the service, and, in addition, said dynamo forms a path for the current of higher voltage from the other dynamo to flow back and cause serious trouble.

In the early days of electric lighting there were many mysterious accidents due to this cause. Two or more engines and dynamos would be running together in parallel, apparently doing their work all right, when suddenly one of the armatures of a dynamo would burn up. In one case, which came under my notice, and which was put to me as an engineering puzzle, there were three high-speed engines running three dynamos, all connected up in parallel and furnishing current for the lighting service of an exhibition Suddenly one generating set stopped dead, a second reversed, and the third ran for a short time and was then observed to be burning. The explanation was very simple. The set which continued to run was generating a slightly higher pressure at its terminals than either of the other two, consequently the others could not deliver any current; in addition the coils of the other two formed paths for the current of high pressure or voltage. The difference between the voltage of the leading machine and the one that reversed was sufficient to allow enough current to pass through its coils to run it as a motor against its own engine, and the difference between the leading machine and the one which stopped was sufficient to bring it to rest, also against the work done by its own engine.

Usually results were not so marked as this. What generally happened was that each engine and dynamo in turn took the lead and carried all the load for a time until its coils became overheated and its insulation badly strained. This condition only became manifest when the inevitable break down took place, and only then because the matter was investigated by an expert who really understood his work.

With the independent system there was no danger of this. Each generating set was apportioned its own share of the load. When the load was light, with lighting during the day, usually only one set was run, and all the circuits were connected to this machine. When the load came on, say at night, certain circuits were switched on to a second machine which was run up for the purpose; this in turn was followed by a third, and so on, the reverse process being followed when the load decreased again. The only danger with this arrangement was that one machine might be left on, doing all the work, after the load had increased beyond its proper figure.

PARALLEL RUNNING.

It may perhaps be well to explain the difference between parallel and independent running. In parallel running the terminals of each dynamo that is furnishing current are connected to what are termed bus bars, usually large, heavy copper bars fixed on the back of the switchboard. The idea of parallel running is that the bus bars act to a certain extent as reservoirs of electricity. All the current that is generated by all dynamos

is taken to the bus bars and all the distributing circuits are connected also to these buses. The engineer in charge can at any minute disconnect any circuit from the bus bars and by so doing cut off its supply of current, and he can similarly disconnect any dynamo. The great beauty of the arrangement is that it is practically automatic, within certain limits. As all the circuits are connected to the bus bars the lamps or motors connected to any one of these circuits receive current in proportion to the pressure delivered to the feeder cables as they are termed, and this pressure can be regulated at the switchboard.

As the load comes on, say toward evening, there is no violent change in the voltage delivered to the lamps which are burning, even when a good many are turned on together, and the engineer connects more and more dynamos as the load increases. As he knows when this will be, he has the additional machines ready to switch on when required. The operation with continuous-current machines is very simple.

The engineer can also arrange so that each set takes a certain portion of the load at any instant. He has complete control of all apparatus by means of adjustable resistance placed in the exciting current of the field magnets of the dynamos, and by altering the admission of steam at the stop valve of the engine.

ARRANGEMENT FOR SMALL PLANTS.

The arrangement described above is that which rules in a generating station where the quantity of current supplied is large and where the attendants have nothing else to do but look after the machinery. In all large stations, and even in some comparatively small ones, there is some one to watch the volt and ammeters placed on the switchboard, but in a small station, such as that on board a steamer, even where the supply is large enough to warrant the use of two or more engines and dynamos, it would usually be out of the question to have all the elaborate apparatus described above.

The usual plan adopted is on tramps and small steamers to have one engine and one dynamo, and on large steamers to have two or more engines and dynamos of total capacity somewhat in excess of that required, and to divide the load between them by a simple switchboard. The dynamos are generally compound wound in these cases, but it is not usual to arrange for altering the current strength passing through the field coils, or to give the engineer in charge the elaborate control that he has in large generating stations. It would be money thrown away, and would probably lead to more break downs than anything else. However, without complete means of control the engineer can never be sure that one of his dynamos is not doing all the work while the others are merely acting as motors, if the machines are run in parallel.

In a steamer and in other small plants where electricity is used for lighting, the electrical apparatus is only one of many others, and the fuel it consumes is usually only a small fraction of the total consumption, so that there is no special reason to provide apparatus of a highly economical type. When it comes to large plants the question of fuel economy is quite different. Then every detail which tends to save fuel should be considered.

The future of electricity looks more hopeful in the British navy. The Lords Commissioners of the Admiralty have recently made some very bold departures in a direction in which, as usual, America has led the way, *i.e.*, the training and rank of officers of the engineering branch. They have also commenced a thorough system of education in electricity, and have gone so far as to appoint an official at the Admiralty to look after electrical matters.

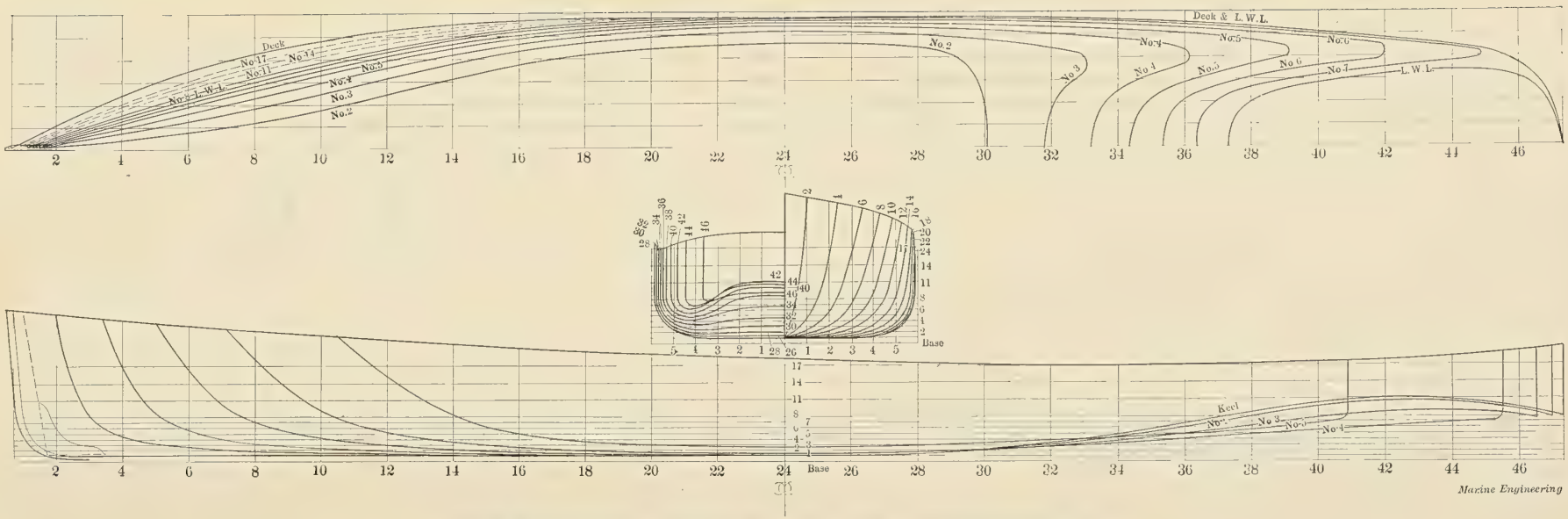
Return of Antartic Expedition.

The Antartic expedition, under Captain Scott, on board the ship *Discovery*, has returned after a successful voyage. Reports from New Zealand state that the expedition found that Wilkes Land was non-existent. Some forms of animal life, consisting mostly of birds, were found, but the only species of vegetable life were morses. Biological evidence indicates that an immense continent once connected the Antarctic land and Australasia. The main practical interest of the expedition lies in the results of the magnetic investigations. Continuous observations were taken in the neighborhood of the magnetic pole.

The ship withstood many severe crushing strains from the ice, and was once blown ashore in a heavy gale. From the *Shipping World* are obtained the following particulars of the *Discovery:*

"The vessel was designed by Mr. W. E. Smith, one of the chief constructors at the Admiralty, and was built by the Dundee Shipbuilders' Company, Ltd., the engines, capable of indicating 450 horse power, having been constructed by Gourley Brothers & Company, Dundee. She is constructed throughout in the strongest possible manner, and is bark rigged, with two decks, with a flat and a short forecastle forward. Accommodation for those on board is provided under the upper deck. The stem is of the ice-breaker type, with strong fortifications. The length of the vessel between perpendiculars is 172 feet; beam, 34 feet; and depth, 19 feet. The timbers are of oak dowelled and bolted together throughout, and the keel, deadwood, stem and stern post are also of oak. The planking is of American elm and pitch pine, and the inside beams are of oak. With the object of avoiding the magnetic influence of iron on the scientific instruments on board, it was decided that for a considerable radius amidships the knees and fastenings should be of naval brass. A heavy wagon-cloth awning of strong woollen felt was provided for 'winter wear.' The fittings and equipment of the vessel are of the most modern type."

Lloyd's Register of Shipbuilding Returns.—For the quarter ended March 31, 1904, returns filed by Lloyd's state that, excluding war ships, there were 398 vessels of 988,644 gross tons under construction in the United Kingdom. Compared with the tonnage of the previous quarter there is an increase of 90,000 tons, but with the total reached in September, 1901, which is the highest on record, the present figures show a decrease of 425,000 tons. Dividing the tonnage into districts gives Belfast the lead with 193,633 gross tons, closely followed by Glasgow and Newcastle.



LINES OF SHALLOW-DRAFT, TWIN-SCREW TUG BOAT USED ON THE SASKATCHEWAN RIVER.

Shallow-Draft, Twin-Screw Tug Boat for the Northwest.

An interesting boat, for an unusual service, has recently been designed by Mr. Morris M. Whitaker, of Toronto, for Captain Deacon, of Prince Albert, N. W. T. The boat is intended for use in towing logs on the Saskatchewan river. The peculiarity of this river is that the sand bars are constantly shifting, and where today there may be six feet of water, to-morrow there may be only six inches. The bottom of the river, however, is soft, so that in the boat here illustrated, no dead wood was provided to protect the propellers or rudder.

The hull is being put together at Prince Albert, and is built throughout of hackmatack, which in Canada is termed tamarac, and practically all the frames are cut from natural crooks. In order to navigate the shallow waters, the twin screws are placed in a tunnel aft, so that the tips of the blades are the same draft as the keel forwards. The principal dimensions of the hull are: length, 70 feet; beam, 12 feet; draft, 21 inches; depth amidships, 4 feet 6 inches.

The keel is 9 by 10 inches, as will also be the keelson, but increases in dimension under the engine and boiler. The frames are 5 by 3 inches at the heel and 4 by 3 inches at the head, spaced 18 inches. The planking is 2 inches up to the water line and 1 1-2 inches above, except in the tunnel for the screws where it is reduced to 1 1-4 inches. The clamps are 9 by 10 inches, deck beams 2 by 6 inches, rubbing strake, or wale, 4 by 5 inches; all these tapered at the end. The deck is of 1 1-2- by 4-inch planking.

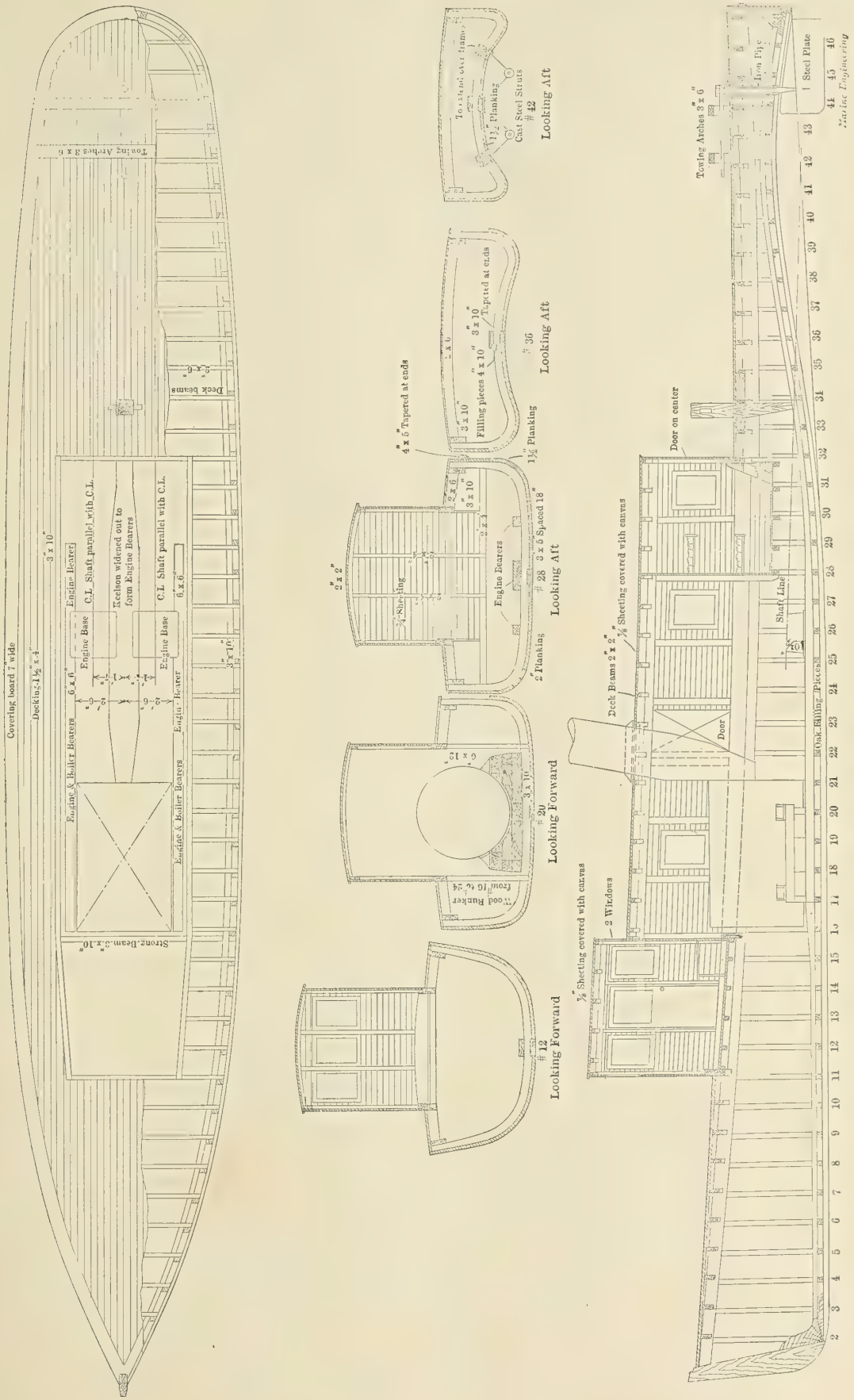
The deck house is very simply constructed of 2- by 4-inch stiffeners with 3-4-inch sheeting tongued and grooved. This is made as simply as possible, for there are very few facilities for doing fancy work at Prince Albert. A small cabin is placed aft of the engine room with two berths.

As wood fuel is plentiful, and can be picked up anywhere along the river, there is only provision in the wood bunkers on each side of the boiler for carrying a cord of wood. The rudder is a steel plate with a steel stock.

The machinery, built by the A. R. Williams Machinery Company, of Toronto, consists of one Scotch return tubular boiler 5-feet diameter by 5 feet 6 inches long designed to carry 125 pounds of steam. On each shaft will be mounted one single high-pressure engine 6 by 8 inches, driving 30-inch propellers, right and left hand.

Throughout, the design of engine and hull have been for a boat to be used in the roughest service far away from repair shop, that could be run constantly with small possibility of breaking down.

Saving From the Use of Oil Fuel.—In the annual report of the president of the Oceanic Steamship Company, it was stated that largely through the adoption of fuel oil on the steamer *Mariposa,* engaged in the Tahiti service, the profit of the last year was $38,309, as against a loss of $19,275 for the previous year. Also, in the direct Honolulu service, on which the steamship *Alameda* runs, a saving of $53,000 resulted from the equipping of this steamer with oil burners. Sixteen voyages were made during the last year.



CONSTRUCTION DRAWING OF THE TUG TO BE USED ON THE SASKATCHEWAN RIVER, DESIGNED BY MORRIS M. WHITTAKER.

STEAM TURBINE PROPULSION FOR MARINE PURPOSES.*

BY PROFESSOR A. RATEAU, OF PARIS.

There is no need, in a country which has given birth to the Parsons turbine, to insist upon the interest attached to the application of the steam turbine to the propulsion of ships. The remarkable results which the distinguished inventor of that engine has obtained are matters of common knowledge, and the author is one of those who have most admired and appreciated the methodical manner in which these results have been achieved. Mr. Parsons has himself set them forth in the paper which he read before the Institution at the last summer meeting.

This important question has also attracted much attention in France for several years past, and I propose, therefore, to give the results which have been so far attained there. If these results are but slender, it is due to the fact that the means at our disposal have not been sufficient to enable more progress to be made.

There are, at the present time, two ships fitted with our turbines, namely, the French torpedo boat No. 243, and a first class torpedo boat built by Messrs. Yarrow & Company. The latter alone has been constructed according to our ideas, as the restrictions imposed by the naval authorities upon the French torpedo boat, and the conditions laid down for its propellers have created such difficulties that it has been impossible up to now to obtain a satisfactory speed with this vessel. It was, however, only a trial boat, and the speed was not required to exceed 20 knots; in point of fact, we have obtained over 21 knots. With Messrs. Yarrow & Company's boat, on the other hand, the conditions are such as to utilize the full value of the turbines, and the latter have been further supplemented by a small reciprocating engine for economical working at reduced speeds. The trials with this boat are, therefore, of considerable practical interest, and I have much pleasure in acknowledging our debt to Mr. Yarrow for the breadth of view which he has shown in dealing with these new conditions.

Another small vessel, the *Libellule,* was to have been fitted with a turbine of our manufacture, and the engine has been completed for some time past, but the trials have not yet taken place, as the special boiler with which it was desired to make the experiments was not ready.

Before going into the details of each of these applications of our system of turbine it may be well to set forth some of the obstacles which arise in using turbines for the propulsion of vessels, obstacles which, in the author's opinion, can only be satisfactorily overcome by a joint use of reciprocating engines and steam turbines.

As to the advantages of turbines, these are well known: absence of vibration, great reduction of weight, ease in handling, absence of wear and tear, etc. There is no need further to insist upon them.

The three principal difficulties in applying turbines to the propulsion of ships are as follows:—

(1) Design and arrangement of propellers for a high speed of rotation.

(2) Efficiency of turbines at low speeds.

(3) Reversing and manœuvring powers.

(1) Arrangement of Propellers for a High Speed of Rotation.

When the turbines are not restricted to any particular speed of rotation, a very high efficiency can be obtained, certainly higher than that of the best reciprocating engines.

The author's experiments confirm this fact, which had already been shown by the published trials of the Parsons turbine. Unfortunately, the best speed for turbines is usually much too great for screw propellers. In high-speed vessels, by some give and take between engine and propeller, a working arrangement can be arrived at; but it is not easy to do. The gearing of the rings has to be higher than with a turbine for other purposes, and the turbine itself must be divided up into several sections in series; and, further, it is necessary to devise some arrangement for the propellers by grouping them either singly, in pairs, or in threes on several shafts, and to so increase their surfaces that the extreme outside diameter shall be greater than the pitch, all of which tends to reduce the total efficiency of the engine and propellers.

If, therefore, the turbine is theoretically superior to the reciprocating engine as regards consumption of steam at full speed, it is not by any means certain, *à priori,* that the joint efficiency of both engine and propeller is better, or even as good.

The practical difficulties, moreover, increase as the speed diminishes, for in the first place the total surface (and consequently the size of the propellers) is mainly determined by the principal cross section of the ship, whereas, on the other hand, the size of the turbines is limited only by the speed of rotation, and not by the power developed. The speed of the turbine must be reduced in proportion to the speed of the ship, so that the dimensions of the former are increased, either by the number or the diameter of the moving rings, whilst the power diminishes approximately as the inverse of the cube of the speed. There is, therefore, a lower limit of speed, below which the use of turbines cannot be recommended. The author has already expressed the opinion (in a paper read before the Association Technique Maritime in 1902) that this limit is in the neighborhood of 20 knots. The author is aware that certain ships now under construction for transatlantic service, and of a proposed speed of 17 knots, are being fitted with turbine engines, but the future will show how these will turn out.

(2) Efficiency at Low Speed.

If the steam turbine is capable of giving good results at the maximum power, it cannot be gainsaid that the results are certainly unsatisfactory at reduced speeds, not so much on account of the reduction of power as on account of the reduction in the speed of rotation, which involves a lowering of what is termed the "hydraulic efficiency" of the turbine. The curves in Fig. 2 show the general behavior of the steam consumption per horse power of a turbine, compared to that of a reciprocating engine, in terms of the speed of the ship, assuming that this consumption is about the same in

*Read at the spring meeting of the forty-fifth session of the Institution of Naval Architects, March 25, 1904.

both cases at the maximum speed. In these approximate curves, it will be seen that at reduced speed the consumption of steam per horse power for the turbine is much higher than for the reciprocating engine. This drawback does not signify in the case of merchant vessels that keep at about their maximum speed. On the other hand, it becomes a serious one for warships that are rarely working at full power. The increase in the coal consumption at speeds of, say, 12 to 15 knots, at which they are usually working, would, however, greatly diminish their radius of action. A partial remedy, as used by Mr. Parsons, may be effected by adding a supplementary turbine for cruising purposes, into which the steam first enters when proceeding at low speeds. This, however, does not improve the hydraulic efficiency of the turbine, and the steam consumption nevertheless remains high.

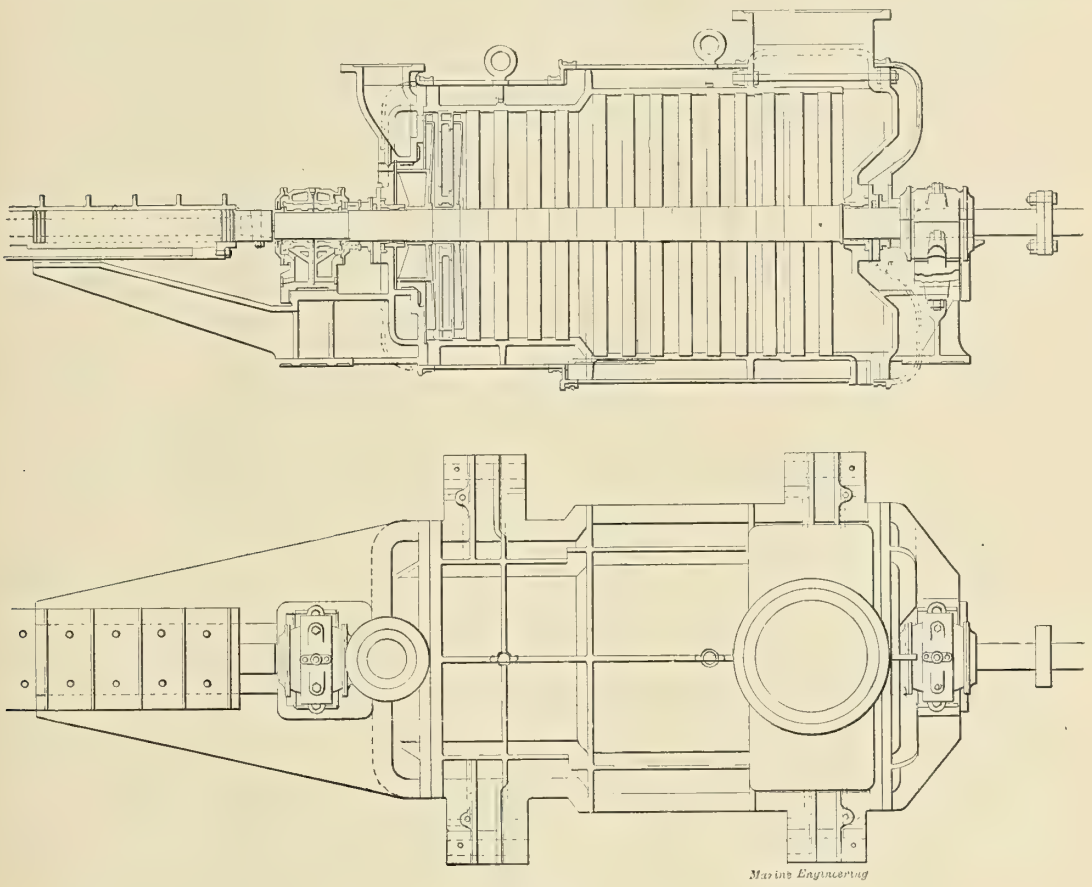


FIG. 1.

The author considers that under no circumstances can turbines alone be economically worked at low speeds, and that the only satisfactory solution is the employment of a reciprocating engine of more or less power, according to the circumstances, in conjunction with turbines. With this combination economical results can be obtained at all speeds, and an example of this will be given later.

(3) Reversing and Manœuvring Powers.

With a reciprocating engine stopping and reversing are effected in the simplest possible manner, whereas the very principle of the turbines is essentially opposed to this. Various inventors have tried to solve this problem by means of special blades to enable the same rings to be used for both directions of motion, but these attempts do not appear likely to come to anything, as one can only obtain reversibility by a considerable sacrifice of efficiency in forward motion. It is, therefore, necessary to supplement the turbine by special engines for going astern, and, as it is obviously impossible to have the latter as powerful as the former, one must be satisfied with a very much lower speed astern than ahead. This difficulty in freely going astern makes manœuvring very awkward. The engine for going astern may be a reciprocating one, which would also be of use for going ahead, but it can just as well be a steam turbine. From the very start, Mr. Parsons used in his vessels special turbines for going astern, and these were attached to the same shafts as the main turbines, but this arrangement has the inconvenience of taking up a good deal of space lengthways.

In my patent of 1898 I have indicated how these can be fitted so as to be, as it were, hidden inside the main turbines on the low-pressure side, and without taking up any additional space. When they revolve freely, the astern rings offer no appreciable resistance while the main turbine is at work, and, conversely, the latter is idle when the astern turbine is in motion. This is the arrangement we have got in torpedo boat No. 243 and in the *Libellule*, and it has the advantage of great sim-

plicity. I think that Mr. Parsons has also made use of a similar arrangement in a certain number of his recent vessels.

According as the astern turbine is more or less developed, so the astern speed is more or less increased. With a single live ring, as on torpedo boat No. 243, and for the same expenditure of steam, the stern speed will be about 40 per cent. of the speed ahead, but with two rings it can be increased to 50 per cent. Adding more rings, however, adds very little to the speed, unless the number is so greatly increased as to make this engine almost as important as the principal one.

For quickly stopping a vessel turbines are apt to be inconvenient. After steam is cut off, the propellers continue to revolve by the action of the water, and they usually carry around with them the live rings, for the resistance to rotation is very slight. One can, however, increase this resistance by admitting steam in the opposite direction on the astern rings.

This question of stopping, reversing, and manœuvring is one which, in the author's opinion, may prove a serious hindrance to the extensive use of turbines for ship propulsion. It is particularly important for warships to be able to manœuver with ease, and it will necessarily lead to the adoption of a combined system of turbines and reciprocating engines.

Combined Use of Turbines and Reciprocating Engines.

For the various reasons given above, the best solution appears therefore to be the simultaneous employment of a reciprocating engine and turbines attached to independent shafts, in order that the reciprocating engine may be used at any speed. Each kind of engine is thus adapted to the work which suits it best. The reciprocating engine does for slow speeds, while the turbines come into play progressively as the higher speeds up to the maximum are required. They can, moreover, be equally well arranged for going astern, and the combination of the two then makes manœuvring almost as easy as with ordinary twin screws. An effective horse power astern of 75 per cent., or more, of that when going ahead can thus be obtained.

The power of the reciprocating engine should not be less than one-sixth of the total, and it can quite well be increased to one-third or even to one-half of the maximum horse power. It may be urged that this arrangement is complicated, and that if such an important reciprocating engine is to be retained, it is better to stick to the present system. In reply to this objection, however, the following advantages may be shown:—

(1) Reduction of weight, although rather more space is taken up in plan.

(2) Easier working and maintenance, and subsequent saving in *personnel.*

(3) Reduction of the vibration due to the reciprocating engines.

(4) Increased efficiency, as the turbine is particularly suited to utilize the expansion of steam up to its extreme limit. It may be estimated that the increase in power for the same consumption of steam would amount to 15 to 20 per cent., or, in other words, that 5 or 6 per cent. increase of speed would be obtained by the arrangement here proposed.

Moreover, this arrangement will make it possible to bring the turbines advantageously into play at a lower limit of speed. With turbines alone, this limit is about 20 knots, whereas, with the combined system, it is possible to begin at 15 knots, or perhaps even less.

Mr. Parsons, in a paper read before the Institution of Shipbuilders and Engineers in Scotland, on "The Marine Steam Turbine and its Application to Fast Vessels," spoke of the speed of rotation of turbines falling when at reduced speed within the limits of those at which reciprocating engines can work, and he proposed to attach the latter on the same shafts as the main turbines, and have both work side by side. At reduced speeds these triple-expansion reciprocating engines would receive steam straight from the boilers, and expand it to, say, atmospheric pressure. The steam would then pass into the high-pressure turbine, and thence into the low-pressure turbine before reaching the condenser. When the power and speed are such that the speed of rotation rises above the limit for reciprocating engines, the steam will be cut off from the latter, and the turbines alone will propel the ship. With this arrangement the reciprocating engines would therefore be useless at the very time when the greatest power is required, and there would, further, be a chance that the engineers might not throw the engines out of gear at the right time, and so cause an accident. This direct coupling of engines, essentially adapted for very different speeds of rotation, is obviously unsound. The only rational arrangement, in the author's opinion, is to make the reciprocating engine mechanically independent of the turbine, by having it act on a shaft and propeller of its own. But, as regards the supply of steam, this can be combined in various ways with that of the turbine, either side by side, as in Messrs. Yarrow's boat, or in series, by having the steam begin on the reciprocating engine and complete its expansion in the turbines. A special combination of this kind, quite different to those already suggested by Mr. Parsons, is what the author advocates.

Results Obtained with the Rateau Turbine.

Description of the Engine.—The author's design of turbine has already been described in several publications. It need only be stated that it consists of a series of flat moving rings, varying in number according to the requirements, and fitted on a single shaft. These rings are placed between circular discs whose rims fit into grooves on the inside of the casing. The shaft traverses these diaphragms through bushes, which allow but little play. Elsewhere, the clearance between the moving and the fixed parts generally exceeds 3 mm., and can even be as much as 5 or 6 mm., without causing trouble. With this arrangement, and by using the work by "impulse" instead of work by "reaction," we have sought to obtain an engine using as little steam as possible, simple in construction, needing but little care in working, and capable of running for a long time with but little wear and tear, which, although inevitable, can yet be reduced to a very small amount. The loss of steam is entirely confined to the clearance allowed around the shaft. Moreover, the live rings are so constructed as to be very light, and this is of advantage

in reducing the gyroscopic effect which comes into play when the vessel pitches.

Fig. 1 shows a longitudinal section and plan of the Rateau turbine. It is taken from the one installed on Messrs. Yarrow's boat. The figure only shows two rings and one diaphragm, as all the others are similar. In this turbine there are 15 moving rings.

It has been said that with this system, supposing one could reduce the loss of steam to a minimum, it would, on the other hand, greatly decrease the efficiency by the friction between the rings and the steam contained in the chambers in which the rings rotate.

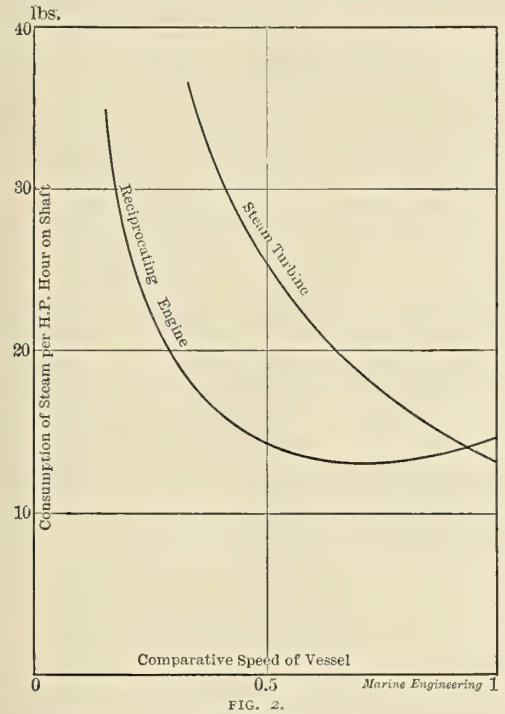


FIG. 2.

As a matter of fact, however, the friction in our engines of 1,000 to 2,000 horse power amounts to only 2 or 3 per cent. of the maximum power—an insignificant proportion—whereas in turbines without diaphragms the loss by the escape of steam reaches 10, 15, and even 20 per cent. of the maximum horse power directly the clearances increase at all. All the trial results so far obtained show that our system of turbine is extremely economical in steam consumption. Here are a few of the principal results obtained:

Turbines of the Torpedo Boat No. 243.—These were the first multicellular turbines which have been constructed from our designs by Messrs. Sautter-Harlé & Company, in Paris. These turbines were designed some five years ago, and several improvemnets have been since effected which considerably diminish the consumption of steam.

A turbine exactly similar to the one installed in torpedo boat No. 243 was tried under the direction of the French Admiralty engineers in the workshops of Messrs. Sautter-Harlé & Company. This engine was coupled to a three-phase alternator, so as to measure exactly the effective horse power of the turbine. The electric current generated was taken up by liquid resistance. As the losses of energy in the alternator had been measured, it was possible to calculate the net effective horse power of the turbine, and consequently its efficiency. By the "efficiency" of the turbine is meant the ratio of the effective power which it develops on the shaft to that which the steam consumed is capable of giving, assuming that there is no loss between the pressure at admission and the pressure at exhaust into the condenser. This experiment gave a result higher by 1 per cent. than had been originally estimated, viz., 54 per cent. instead of 53 per cent., and the results are shown in Fig. 3. The curves there drawn are obtained by reducing the speed of rotation to the uniform speed of 1,700 revolutions per minute, and the condenser vaccuum to 26 inches of mercury. It will be seen that at full power, with a steam pressure at admission to the turbine of 145 pounds per square inch, the consumption per effective horse power on the shaft is 15.2 pounds. At the normal speed of 1,800 revolutions per minute, for which the engine was designed, the efficiency is rather higher, and the steam consumption rather lower.

We can now make engines of this power with 60 per cent., or even 70 per cent., efficiency, according to the speed of rotation, which can be used for the turbines, depending on the use for which they are designed.

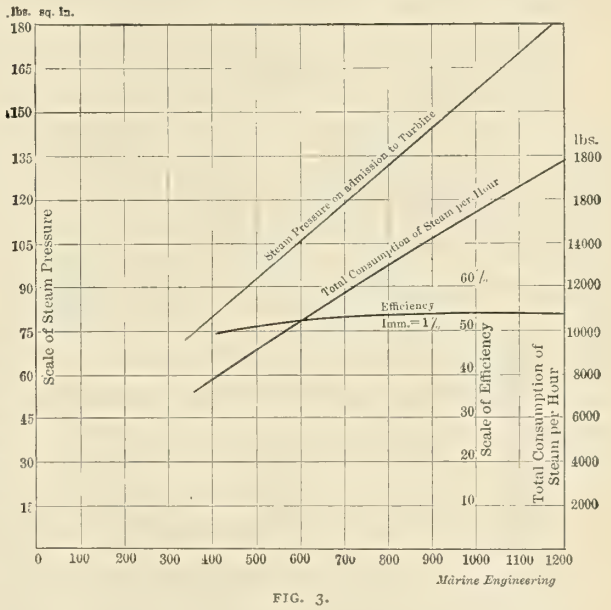


FIG. 3.

The turbine for the Yarrow boat has not yet been tested at the works up to its full speed, but from previous calculations it is estimated that the efficiency should be 61 per cent. at a maximum of 2,000 horse power, with a normal speed of 1,500 to 1,600 revolutions per minute. The loss due to friction between the rings and the steam is only 41 horse power, or 2 per cent. With 170 pounds per square inch pressure, and a vacuum of 27 inches, the consumption of steam of this engine is $\frac{8.2}{0.61} = 13.4$ pounds per effective horse-power hour, which corresponds to 11.7 pounds per indicated horse power for a reciprocating engine having 12 per cent. loss due to internal friction.

Other turbines driving alternators, continuous-current dynamos, centrifugal pumps or fans, and constructed by Messrs. Sautter-Harlé, have been carefully tested, and among the results obtained I would call attention to the following:—

An engine of 600 horse power, at 2,400 revolutions per minute, consumes 14.6 pounds per electrical horse power per hour. The efficiency of the dynamo being 91 per cent., it follows that the consumption of steam for the turbine was 13.3 pounds per effective horse-power hour, or 11.3 pounds per indicated horse-power hour, assuming the efficiency of the reciprocating engine to be 85 per cent., the steam pressure at admission being 142 pounds and the condenser vacuum 26 inches.

An engine of 350 horse power driving an alternator at 3,000 revolutions per minute showed a consumption of 26.2 pounds per kilowatt generated by the alternator (including exciter), the steam pressure at admission being 152 pounds, and the condenser vacuum only 24 inches. The efficiency of the alternator being 87 per cent., this corresponds to a steam consumption of 14.1 pounds per indicated horse-power hour. It will be seen that this was a case of a relatively weak engine working with a very poor condenser vacuum.

A low-pressure turbine of 350 horse power, installed in a mine at Bruay, gave an efficiency rather higher than the above, the total efficiency of the turbine and dynamo combined reaching 58 per cent., or for the turbine alone 63 per cent. Recent tests have shown that the efficiency of this engine has remained the same after a year and a half of continuous work, and no appreciable increase in total steam consumption for the same amount of energy produced has been observed.

A turbine pump of 500 horse power, for raising 950 gallons per minute to a height of over 1,200 feet, and which was recently tested, gave a consumption of 22.5 pounds per horse-power hour in actual water raised, the pressure at admission being 90 pounds per square inch, and the condenser vacuum 26 inches. The efficiency of the pump being 70 per cent., this corresponds to an efficiency of 61 per cent. for the turbine. In all the above cases the steam was not superheated.

It will be seen from these examples that even for engines of only 300 to 600 horse power a working efficiency of over 60 per cent. can be obtained, while for engines of 1,000 horse power and over it is certain that upwards of 65 per cent. efficiency can be realized, as already stated. Hence it is easy to arrive at the consumption of steam per E.H.P. under various circumstances, by using the formula which I have already given. For instance, we could guarantee that for an engine of 5,000 to 6,000 horse power, supplied with steam at 150 pounds, and superheated to 350 degrees Centigrade, with 28-inch vacuum, the consumption per E.H.P. would not exceed 9.6 pounds, which corresponds to 8.6 per horse-power hour, assuming 10 per cent. to be lost in internal friction.

In order to properly understand the value of these figures, it is necessary to compare them with those obtained with reciprocated engines. When the expansion of steam in the cylinder has been carried sufficiently far, which occurs at from one-half to two-thirds of full power, the efficiency of powerful reciprocating triple-expansion engines is as much as 62 per cent. (this is net efficiency—that is to say, the ratio between the work performed on the shaft and the work that the same amount of steam would give with no loss). But this is not the case when the engines are working at full power, for then, in order not to increase the weights too much, especially on warships, one must increase the admission to the cylinder up to and even beyond 70 per cent. From an investigation made by Mr. Lelong, a French Admiralty engineer, published in the "Transactions of the Association Technique Maritime" (1899), the efficiency in work delivered on the pistons of several engines of from 3,600 to 8,400 horse power, varies from 51.7 per cent. to 57.8 per cent., or an average of 55.2 per cent. (Carnot, Charles-Martel, du Chayla, Galilée, Lavoisier). Deducting therefrom 8 per cent. for internal friction losses, this would leave 51 per cent. for the net efficiency, whereas, from what has been said above, steam turbines can easily yield over 60 per cent. net efficiency when working at full power.

I will now give a few details of the application of these turbines to ship propulsion.*

Torpedo Boat No. 243.

Five years ago, in 1898, the French Admiralty began to experiment with steam turbines for the propulsion of warships. Knowing that we had already given attention to this question, the Admiralty invited Messrs. Sautter-Harlé and the author to supply engines of this kind for a torpedo boat of ninety-two tons. The object of the experiment was also to investigate the working of combinations of propellers. In order to reduce expenses, it was laid down that the hull of an ordinary torpedo boat should be used, and that the turbine should be installed in the space usually occupied by the reciprocating engines, in order to allow the latter to be replaced in position, if necessary, at the end of the experiment. This arrangement caused a great deal of inconvenience in the installation of the turbines and propellers, and it ultimately resulted in the trial not being so conclusive as it should have been. It was naturally very difficult to adapt turbines to a hull designed for a reciprocating engine, as the cross section of the boat has a distinctively V-shaped outline in its lower part, whereas, for the turbines, which have to be arranged one on each side of the centre line, the cross section should have been much flatter on the floor. Hence the impossibility of sufficiently lowering the main shafts where they enter the turbines, which involved their being very steeply inclined, viz., 11 per cent. off the horizontal. Each shaft carried three propellers, and was supported at two points by long brackets fixed to the hull.

These conditions were very unfavorable, the steep inclination of the shafts operating against the efficiency of the propeller, and this was fully brought out in the trials, while the excessive length of the brackets aft considerably increased the total resistance of the vessel. As regards the turbines themselves, they have given very satisfactory results, as shown in the reports of the

*There are, at the present time, either in use or in process of construction, over fifty turbines of the Rateau design, with an aggregate of 25,000 H. P., of which 6,200 H. P. are used for ship propulsion, 950 H. P. for turbine pumps, and 760 H. P. for turbine fans.

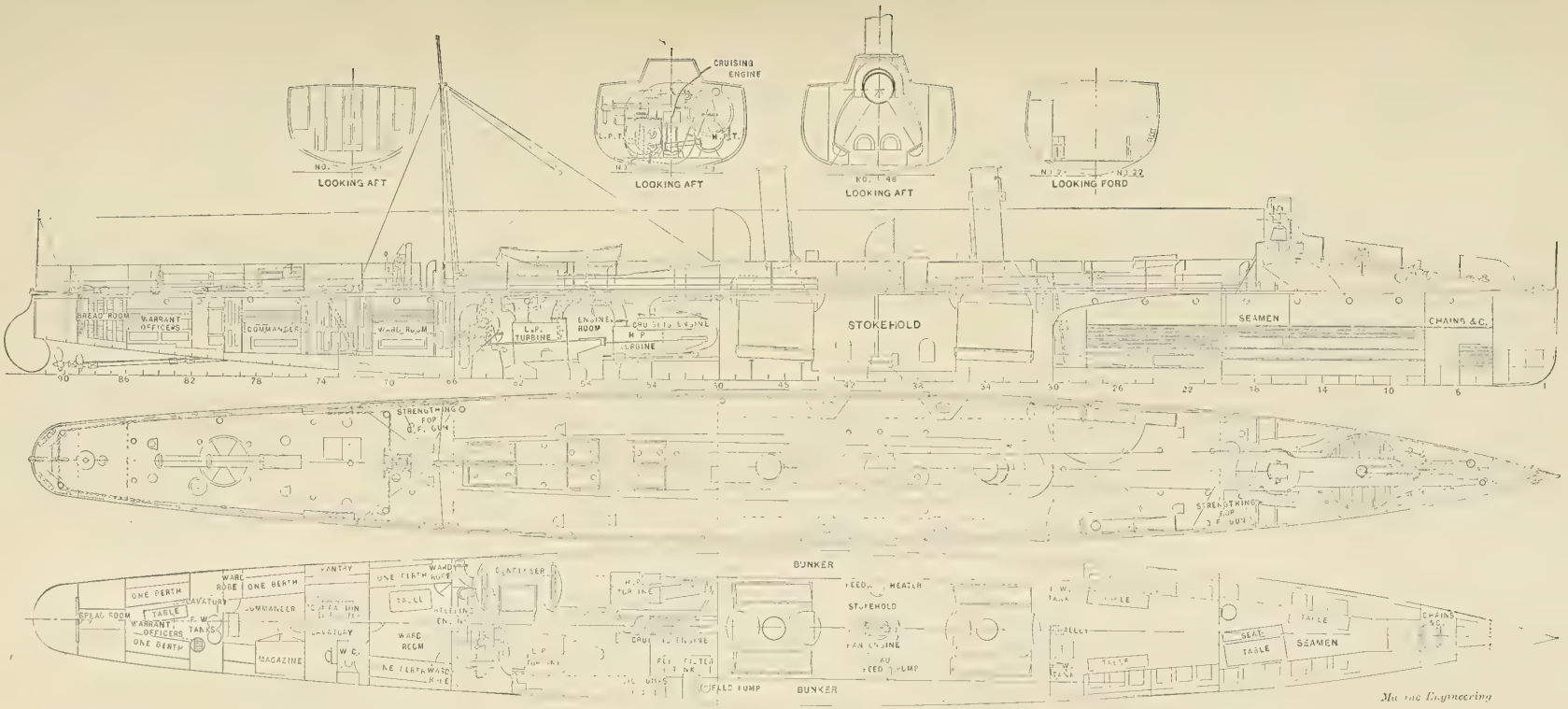


FIG. 4.—GENERAL ARRANGEMENT OF FIRST-CLASS TORPEDO BOAT, FITTED WITH TWO TURBINES AND ONE RECIPROCATING ENGINE.

trials. The two turbines, of 900 horse power (nominal) each, are quite independent of one another. On the exhaust side they enclose a single moving ring for going astern, and in this first attempt we voluntarily sacrificed power in going astern. The chief object, as has been stated, was to see if the combination of turbines and small propellers could give the vessel anything like the speed she would have obtained with reciprocating engines. In point of fact, 21 knots only was the speed obtained, whereas it should have been 24 knots, as the turbines themselves gave rather more power than had been estimated, and this difference is principally attributable, as already stated, to the steep sloping of the propeller shafts.

At the first trials we had some trouble with oil getting into the condenser. This arose from having designed a joint of oil under pressure at the point where the shaft enters the turbine on the low-pressure side. This joint effectually prevented the ingress of the air, but caused a considerable flow of oil to the condenser. To remedy this we put the low-pressure bearing completely outside the turbine and used a novel system of stuffing. As to the other bearings, one at the middle of the shaft and the other at the high-pressure end, they both remained inside the turbine. Lubrication was effected by pumping in oil from the outside, and the excess oil afterwards collected.

After the alteration in the low-pressure bearing, the engines worked very satisfactorily, and although each turbine now has two internal bearings, the leakage of oil to the condenser is very slight, and compares favorably in this respect with a reciprocating engine. Since July, 1902, there have been a large number of trials with this boat in the presence of French Admiralty engineers, and no less than six different arrangements of propellers, distributed in pairs or by threes on each shaft, have been tried. The speeds obtained have varied greatly according to the arrangement of the propellers, but at full power the highest speed varies from 18 to 21 knots, corresponding to a variation of efficiency of 40 per cent. The full details of these trials cannot be given here. I will, however, give the results of

two trials made with propellers of 23.6 inches pitch and 20.9 inches diameter in one case, and 19.7 inches pitch and 23.6 inches diameter in the other. The first trials are summarized in Table A.

Boat Built by Messrs. Yarrow & Company.

Fig. 4 represents the vessel of Messrs. Yarrow & Company, on which the author's system of turbines has been installed. She is a sister ship to the *Tarantula*, which, as is well known, was fitted with a Parsons turbine, and is similar, apart from the system of propulsion, to the first-class torpedo boats of the British Navy.

Displacement	140 tons.
Length	152 ft. 6 in.
Breadth	15 ft. 3 in.

The boilers, of the well-known Yarrow type, are the same as are usually fitted on first class torpedo boats, and are capable of giving a maximum speed of from 26 to 27 knots with ordinary reciprocating engines.

The boat here described was fitted with three propeller shafts, actuated simultaneously and separately by turbines and a reciprocating engine; the latter (of 250 H.P.) works the central shaft, and is quite independent of the turbines, receiving steam directly from the boilers, and exhausting directly into the condenser. This central shaft only carries one propeller, which is 4 feet in diameter.

The side shafts, which are arranged to carry either one or two propellers each, are worked by a turbine in two sections, arranged in series, and rotating in opposite directions. Fig. 1 shows the longitudinal section of the high-pressure turbine. It will be seen that the supports for the thrust bearings have been increased in order to take the full thrust of the propellers. This thrust, being nearly balanced by that of the steam on the drum inside the turbine, it would have been quite possible to reduce the bearings by one-fifth.

The combination of reciprocating engine and turbine as adopted by Mr. Yarrow had already been advocated by Mr. Nabor Soliani, director of the Ansaldo Works, Genoa (see *Engineering*, March 28, 1902). But this is not the only possible arrangement, and an even better one, in the author's opinion, is, instead of letting the reciprocating engine exhaust directly into the condenser, to lead the exhaust steam into the low-pressure turbine, or even, under certain circumstances, into the high-pressure turbine. The author had previously arrived at this conclusion as being the only rational arrangement for economical working at slow speeds.

The turbines were built at the Oerlikon Works in Switzerland.

The total weight of the turbines, which are capable of giving upwards of 2,000 horse power, is 17,200 pounds, or 8.6 pounds per horse power, and this could be reduced by diminishing the thickness of the turbine casings, which have been made unnecessarily heavy, and by suppressing the supports of the thrust blocks.

At the point where the shafts pass through the ends of the casing, water-tightness is obtained by the same system of packing that is employed with land turbines. A special regulator governs the pressure on the four glands so as to prevent any access of air. With this arrangement it is easy to obtain a good vacuum in the condenser, and one of the two air pumps originally installed has consequently been suppressed. As will be seen in the following table, the vacuum has, with a single air pump, been kept constant at 27 inches at all powers.

Several trials have been made with this boat from October 13, 1903, up to quite recently, and the author was present at some of these trials, which were under the immediate supervision of Mr. Marriner, chief engineer to Messrs. Yarrow & Company.

First Trials.—The first trials were made on October 13, 1903, each propeller carrying a single screw of three blades of 32 inches diameter, and 30 inches pitch. The following table (Table C) gives a summary of the results obtained by progressively increasing the pressure of steam supplied to the high-pressure turbine. In the first run no steam was supplied to the turbines, the reciprocating engine alone being employed, and the turbines turning idly by the action of the water on the propellers.

In the diagram (Fig. 5) the mean speed of the vessel in knots is given along the base line, and the diagram shows:—

Curve A—Steam pressure in the turbines.

Curve B—Slip of the screw with reciprocating engines.

Curve C—Slip of the screw with high-pressure turbines.

Curve D—Slip of the screw with low-pressure turbines.

It will be seen from the above diagram that the estimated speed of 25 knots was obtained at the first trial, although the turbines were never working at the full effective pressure allowed for in the design, viz., 156 pounds. The curves of the slip of the screws shows that at 21 knots speed the propeller surface is sufficient, but above this speed it is rather too small, and it was consequently decided to increase its surface by adding a second propeller to each of the shafts.

It is interesting to follow the variation in slip of the different screws, as the power of the turbines is increased. With no steam in the turbines, and the vessel being propelled by the reciprocating engine alone at a speed of about 12 knots, the slip of the central propeller is about 40 per cent., while the water causes the wing propellers to turn the turbines at the rate of about 400 revolutions per minute. As the power of the turbines increases, the slip of the middle screw is reduced to about 7 per cent., while the slip of the turbine propellers, on the contrary, beginning at zero, increases progressively to upwards of 30 per cent. for the high-pressure turbine and 39 per cent. for the low-pressure turbine propeller. The difference between these two figures arises from the fact that the low-pressure turbine gives notably more power than the high-pressure turbine, owing to its condenser being better than was expected.

Owing to the considerable reduction in the slip of the central propeller, as the wing propellers come more and more into play, the speed of rotation of the reciprocating engine does not increase in proportion to the speed of the vessel. By referring to the table, it will be seen that, at the reduced speed of 12 knots, the speed

of rotation of the reciprocating engine is 369 revolutions, and at 25 knots (or double the first speed) only 516 revolutions per minute. On examining the curves of the turbines, it will be seen that their speed of rotation rises from 393 to 1,455 revolutions for the high-pressure turbine, and from 395 to 1,657 for the low-pressure turbine, while the speed of rotation allowed for in the design was 1,500 to 1,600 revolutions per minute. As regards the steam consumption, with the combined system of engines, this is very moderate at a speed of 10 knots, and probably considerably less than when reciprocating engines, equal to the full power required, are worked at very low powers.

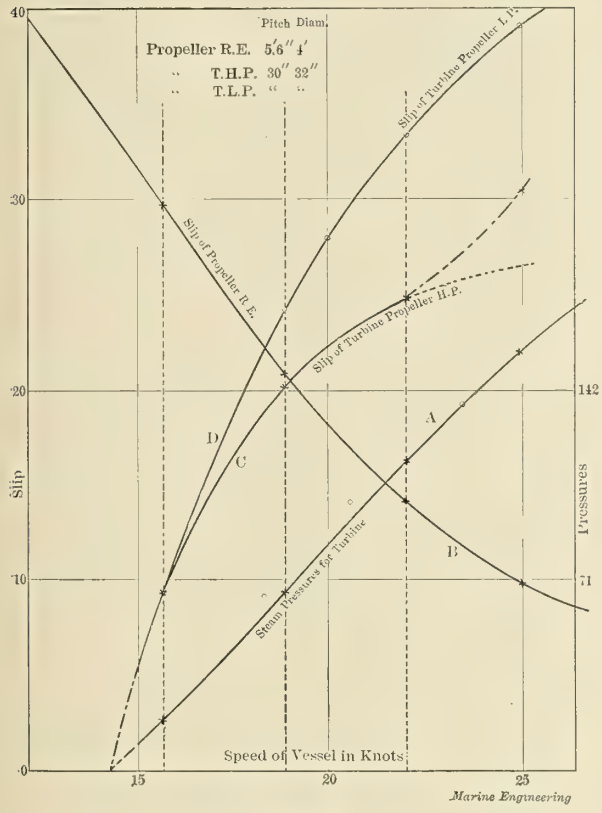


FIG. 5.

Second Trials.—A second series of trials was made on January 19, 1904, after the propellers had been altered, the middle one being reduced to 3 feet 6 inches diameter, the pitch being kept at 5 feet 6 inches. The high-pressure turbine was fitted with propellers of 2 feet 4 inches and 2 feet 8 inches diameter respectively, but both of the same pitch, while the low-pressure turbine was fitted with propellers of 2 feet 4 inches and 2 feet 10 inches diameter, and 2 feet 6 inches and 2 feet 10 inches pitch respectively. The results obtained are summarized in Table D.

It will be seen that a speed of 26.39 knots has been obtained by giving the turbines rather more steam than they had been designed for. For the same steam pressure at admission—that is, for same steam consumption—the speed is less than in the first trials except at the maximum speed, when it is about the same. The slip of the screws is much reduced, as also the speed of rotation of the turbines. It may, therefore, be inferred that two screws give better results than the single screw originally employed; for, the speed of rotation of the turbines having been greatly reduced, their efficiency is much less. To increase this speed and obtain the estimated efficiency, the propeller surface must be reduced, and this was done for the third series of trials.

A point of interest is that the addition of a screw revolving in the neighborhood of the hull gave rise to considerable vibration, whereas in the first trials the complete absence of vibration was specially noteworthy.

Third Trials.—A third set of trials was made on March 4, 1904, with propellers all of the same pitch (2 feet 6 inches) and rather smaller diameter (2 feet 6 inches, 2 feet 4 inches, 2 feet 1 inch). The speeds obtained were approximately equal to those of the second trials, for the same steam pressures in the H.P. turbine, but the speeds of rotation of the turbines were increased by 16 per cent. The increase in the efficiency of the engines was therefore balanced by the reduction in the efficiency of the screws, the slip of which rose to 24.6 per cent. for those of the H.P. turbine, and 33.1 per cent. for those of the L.P. turbine. It seems to be difficult to obtain more than this with propellers grouped in pairs on each shaft. This arrangement of two propellers, one in front of the other, is defective, in so far that the second propeller works in water already disturbed by the first propeller. The highest efficiency is certainly obtained with a single propeller on each shaft, but, in order that the slip should not exceed 25 per cent., which seems to be the maximum for a good duty, the propelling surface, and consequently the diameter, must be increased. This can be easily done when the shafts are nearly horizontal. On Messrs. Yarrow's boat, the inclination of the shafts is rather steeper than it should be with propellers having a diameter greater than the pitch. Nevertheless, the speed of 26.4 knots, which has already been obtained, is no doubt capable of being improved upon, and the maximum obtained with reciprocating engines can no doubt be easily reached.

In conclusion, it will be seen from what has been said, that steam turbines can be made practically equal to reciprocating engines for propelling ships at high speeds, but in order to obtain their full effect, they must be mounted upon shafts very slightly inclined, and, if possible, with only one propeller on each shaft. The necessity for having horizontal shafts leads to a more sudden rise in the hull aft than is usual when reciprocating engines are installed. Hence hulls constructed for reciprocating engines are not generally suitable for steam turbines. It must not be concluded from the fact that, *cæteris paribus*, a higher speed is not obtained by merely substituting turbines for reciprocating engines, that the former are therefore inferior to the latter. A new form of propelling engine obviously calls for new lines of hull. At reduced speeds, the turbines are not economical, and they are inconvenient for going astern and for manœuvring, but this drawback can quite well be remedied by combining turbines with a reciprocating engine, working a special shaft and mechanically independent of the turbines. Another arrangement, different from that in the Yarrow boat, whereby the reciprocating engine would supply about 40 per cent. of the total power, would give an increase

of 15 to 20 per cent. of the power obtained with a reciprocating engine alone, besides having the general advantages characteristic of turbines.

TABLE A.

Torpedo Boat No. 243. Trials of January 22, 1903.
Six propellers: Diam., 23.6 inches; Pitch, 19.7 inches.

Number of Trial.	I.	II.	III.	IV.
Speed of vessel (in knots)—mean of three runs....	17.07	19.59	20.94	21.26
Rotation of turbines—revs. per minute	1,348	1,572	1,748	1,774
Effective pressure of steam on admisson to turbines—pounds per square inch	68.26	100.98	129.42	132.26
Condenser vacuum—inches	28	28	27	27.5
Mean slip of propellers	0.217	0.230	0.260	0.260

With the other arrangement of propellers (20.9 inches pitch and 23.6 inches diameter), the following results were obtained:—

TABLE B.

Torpedo Boat No. 243. Trials of December 6, 1902.
Propellers: Diam., 20.9 inches; Pitch, 23.6 inches.

Number of Trial.	I.	II.	III.	IV.	V.
Speed of vessel (in knots)—mean of two runs	14.90	16.59	18.73	18.83	20.89
Rotation of turbines—revs. per miuute	1,051	1 213	1,386	1.392	1.556
Effective pressure of steam on admission to turbines—pound per square inch	104.5	80	?*	99.5	115
Condenser vacuum—inches	26.4	26.4	26	26.4	26.8
Mean slip of propellers	0.279	0.304	0.311	0.311	0.316

The torpedo boat No. 243 was built by the Société des Forges et Chantiers de la Méditerranée, at Havre, where its trials were run.

TABLE C.

Messrs. Yarrow & Company's Torpedo Boat. Trials of October 13, 1903.
Wind rather strong.

Number of Trial.	I.	II.	III.	IV.	V.
Number of runs on measured mile	3	2	2	2	3
Effective pressure of steam on admission to H. P. turbine—pound per square inch	—	50	50	100	145
Condenser vacuum—inches	26.8	28	28	27.2	26.9
Speeds attained in various runs (in knots)	10.68	17.39	20.66	23.84	27.69
	13.50	13.70	16.76	20.00	22.36
	10.30	—	—	—	27.48
Mean speed of vessel (in knots)	11.98	15.54	18.71	21.92	24.97
Rotation of reciprocating engine—revs. per minute	369	411	441	475	516
Rotation of H. P. turbine—revs. per minute	393	688	955	1,172	1 455
Rotation of L. P. turbine—revs. per minute	395	687	994	1.357	1.657
E. H. P. developed on shaft of reciprocating engine	239	260	251	235	232
Slip of propellers—					
Reciprocating engine—per cent	39.5	29.7	21.0	14.0	9.7
H. P. turbine—per cent	—	8.9	20.6	24.5	30.5
L. P. turbine—per cent	—	8.9	24.0	35.0	39.0

The E. H. P. developed on shaft was arrived at by deducting 10 per cent. from the H. P. recorded by the watt indicator.

*Owing to the failure of the gauges, the pressures in the turbines could not be taken on this trial.

TABLE D.

Messrs. Yarrow & Company's Torpedo Boat. Trials of January 19, 1904.

Number of Trial.	I.	II.	III.	IV.
Effective pressure of steam on admission to H. P. turbine—pound per square inch	50	100	150	170
Condenser vacuum—inches	28	27.5	27	27
Speed of vessels (two runs)—knots.	15.58	19.25	23.22	25.714
	20.00	23.53	26.67	27.067
Mean speed of vessel—knots	17.79	21.39	24.94	26.39
Rotation of reciprocating engine—revs. per minute	458	508	555	576
Rotation of H. P turbine—revs. per minute	836	1 052	1,207	1,258
Rotation of L. P. turbine—revs. per minute	836	1,065	1.232	1,307
Slip of propellers—				
Reciprocating engine—per cent	28.7	22.4	17	15.3
H. P. turbine—per cent	13.6	17.4	16.4	14.8
L. P. turbine—per cent	24.0	28.2	27.8	27.8

AMENDED STEAMBOAT RULES AND REGULATIONS.

At the regular annual meeting of the Board of Supervising Inspectors, Steamboat Inspection Service, held in Washington, D. C., in January and February, 1904, amendments were made to some of the sections of the general rules and regulations.

Following is the text of the rules amended in part only, the parts struck out inclosed in brackets [thus], while the additions to such paragraphs are printed in *italics*. Entirely new sections and paragraphs of sections are in plain type preceded by the word (new) in parentheses.

RULE II.

Section 14.

14. Corrugated furnace flues constructed with corrugations 8 inches from center to center, the radius of outer corrugation being not more than one-half of the reverse or suspension curve, the plain parts at the ends not exceeding 9 inches in length, made of plates not less than 5-16 of an inch thick, when new, corrugated with practically true circles, shall be allowed a steam pressure in accordance with the following formula:

$$\text{Pressure in pounds} = \frac{[15{,}000]\ 14{,}000}{D} \times T.$$

Where T = thickness in inches,
D = mean diameter in inches.

Section 28. (First four paragraphs new.)

28. The areas of all safety valves on boilers contracted for or the construction of which commenced on or after July 1, 1904, shall be determined in accordance with the following formula and table:

$$\text{Formula: } a = .2074 \times \frac{W}{P}.$$

Where a = area of safety valve, in square inches, per square foot of grate surface.

W = pounds of water evaporated per square foot of grate surface per hour.

P = absolute pressure per square inch = working gauge pressure + 15.

From which formula, the areas required per square foot of grate surface, in the following table,* are found by assuming the different values of W and P.

*The table is not given in this magazine, as it is simply derived from the above formula.

The figures (*a*) in table multiplied by square feet of grate surface give the area of safety valve or valves required.

When this calculation results in an odd size of safety valve, use next larger standard size.

Any spring-loaded safety valve constructed so as to give an increased lift by the operation of steam, after being raised from its seat, or any spring-loaded safety valve constructed in any other manner so as to give an effective area equal to that of the aforementioned spring-loaded safety valve, may be used in lieu of the common lever-weighted valve on all boilers on steam vessels, and each spring-loaded valve shall be supplied with a lever that will raise the valve from its seat a distance of not less than that equal to 1-8 of the diameter of the valve opening. But in no case shall any spring-loaded safety valve be used in lieu of the lever-weighted safety valve without first having been approved by the Board of Supervising Inspectors.

The valves shall be so arranged that each boiler shall have at least one separate safety valve, unless the arrangement is such as to preclude the possibility of shutting off the communication of any boiler with the safety valve or valves employed. This arrangement shall also apply to lock-up safety valves when they are employed.

The use of two safety valves may be allowed on any boiler, provided the combined area of such valves is equal to that required by rule for one such valve.

The seats of all safety valves shall have an angle of inclination of 45 degrees to the center line of their axes.

All common lever safety valves to be hereafter applied to the boilers of steam vessels must be constructed in material, workmanship, and principle according to the drawings for a safety valve referred to in this section.

RULE V.

SECTION 14. (New, inserted after seventeenth line of first paragraph.)

Practical service in the deck department of a steam yacht of over 100 tons, cruising on inland waters, when offered in documentary evidence by a person applying for a pilot license or raise of grade, shall be accepted as being equal to the same amount of service on any inland passenger vessel.

SECTION 14. (New, inserted before the word "*Provided*" in fourteenth line of third paragraph.)

Practical service in deck department of an ocean-going or coastwise steam yacht shall be accepted when offered in documentary evidence by any person applying for an original license or raise of grade on ocean-going or coastwise steam vessels as being equal to the same amount of service in any ocean-going or coastwise steam passenger vessel.

SECTION 14. (New, at end of section.)

And the holder of a license as a first-class pilot may have the same indorsed, without examination, as master of lake, bay, sound, or river steamer of 150 tons or under engaged exclusively in towing.

SECTION 25. (First paragraph.)

25. Starting, stopping, and backing signals for steam vessels navigating the waters of the eighth and ninth supervising inspection districts, and so much of Lake Superior as is included in the fifth district, *excepting the waters of Lake Champlain.*

SECTION 27. (Second paragraph.)

Whenever the owner or sailing master of a steam or sailing yacht [of over 100 gross tons], who has had three years' experience in sailing such vessels, applies for a license authorizing him to act as master of steam yachts for coastwise and ocean navigation, the local inspectors shall examine the applicant . . . (Rest of paragraph unchanged.)

RULE VI.

SECTION 7. (First paragraph.)

7. Certificates of inspection for any period less than one year shall not be issued, but nothing herein shall be construed as preventing local inspectors from inspecting steamers for renewal of certificate, upon due application in writing, at any time not exceeding [ten] *thirty* days of expiration of current certificate of inspection, providing the same can be done without greater expense than would be incurred if taking place when inspection is regularly due, and that such inspection shall not interfere with other inspections regularly falling due at the same time. This rule, however, is not to be construed as preventing the inspection of any steamer at an earlier period than [ten] *thirty* days anterior to the expiration of the steamer's certificate, when such steamer has been practically rebuilt, or when necessary "for the purpose of concentrating the work of the inspectors within certain given periods" . . . for the purpose of saving traveling expenses, or in the case of sea-going steamers, foreign or coastwise, whose inspection certificates would expire on a voyage previous to the return of the vessel to the port where usually inspected.

Several forms of new appliances were approved by the board, including life preservers, life boats, fusible plugs, boilers, etc.

The above amendments to the rules received the approval of the Secretary of Commerce and Labor and now have the force of law.

CONGRESSIONAL MARITIME LEGISLATION.

The last Congress passed several measures tending to aid American shipping. The Gardner bill, as mentioned in a previous issue, provides for a commission of five senators and five representatives to inquire into the state of the merchant marine and report to the next Congress. This commission has held its first session and has laid out a comprehensive line of work for the summer. Other bills are given in full below.

CARRYING GOVERNMENT SUPPLIES IN AMERICAN SHIPS.

"*Be it Enacted by the Senate and House of Representatives of the United States of America in Congress Assembled.* That vessels of the United States or belonging to the United States, and no others, shall be employed in the transportation by sea of coal, provisions, fodder, or supplies of any description, purchased pursuant to law, for the use of the army or navy unless the president shall find that the rates of freight charges by said vessels are excessive and unreasonable, in which case contracts shall be made under the law as it now exists: *Provided,* That no greater charges be made by such vessels for transportation of articles for the use

of the said army and navy than are made by such vessels for transportation of like goods for private parties or companies.

"SEC. 2. That this act shall take effect sixty days after its passage."

MINIMUM TONNAGE OF VESSELS IN FOREIGN TRACT.

"Be it Enacted by the Senate and House of Representatives of the United States of America in Congress Assembled, That section 3,095 of the Revised Statutes is hereby amended so as to read as follows:

"SEC. 3,095. Except in the districts on the northern, northwestern, and western boundaries of the United States, adjoining to the Dominion of Canada or into the districts adjacent to Mexico, no merchandise of foreign growth or manufacture subject to the payment of duties shall be brought into the United States from any foreign port in any other manner than by sea, nor in any vessel of less than 30 net register tons, or landed or unladen at any other port than is directed by law, under the penalty of seizure and forfeiture of all such vessels and of the merchandise imported therein, laden or unladen in any other manner.

"SEC. 2. That this act shall take effect one month after its passage."

PHILIPPINE SHIPPING BILL.

Be it Enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That on and after July 1, 1906, no merchandise except supplies for the army and navy, shall be transported by sea, under penalty of forfeiture thereof, between ports of the United States and ports or places in the Philippine archipelago, directly or via a foreign port, or for any part of the voyage, in any other vessel than a vessel of the United States. But this section shall not be construed to prohibit the sailing of any foreign vessel between any port of the United States and any port or place in the Philippine archipelago: provided, That no merchandise other than that imported in such vessel from some foreign port which has been specified on the manifest as for another port, and which shall not have been unloaded, shall be carried between a port of the United States and a port or place in the Philippine archipelago.

SEC. 2. That on and after July 1, 1906, no foreign vessel shall transport passengers between ports of the United States and ports or places in the Philippine archipelago, either directly or by way of a foreign port, under a penalty of $200 for each passenger so transported and landed.

SEC. 3. That sections one and two of this act shall not apply to the transportation of merchandise or passengers between ports or places in the Philippine archipelago. Until congress shall have authorized the registry as vessels of the United States of vessels owned in the Philippine archipelago, the government of the Philippine Islands is hereby authorized to adopt, from time to time, and enforce regulations governing the transportation of merchandise and passengers between ports or places in the Philippine archipelago.

SEC. 4. That sections one and two of this act shall not apply to the voyage of a vessel between a port of the United States and a port or place in the Philippine archipelago begun before July 1, 1906.

SEC. 5. That sections one and two of this act shall not apply to vessels owned by the United States.

SEC. 6. That on and after the passage of this act the same tonnage taxes shall be levied, collected, and paid upon all foreign vessels coming into the United States from the Philippine archipelago which are required by law to be levied, collected, and paid upon vessels coming into the United States from foreign countries: *Provided, however,* That until July 1, 1906, the provisions of law restricting to vessels of the United States the transportation of passengers and merchandise directly or indirectly from one port of the United States to another port of the United States shall not be applicable to foreign vessels engaging in trade between the Philippine archipelago and the United States: *And provided further,* That the Philippine Commission shall be authorized and empowered to issue licenses to engage in lighterage or other exclusively harbor business to vessels or other craft actually engaged in such business at the date of the passage of this act, and to vessels or other craft built in the Philippine Islands or in the United States and owned by citizens of the United States or by inhabitants of the Philippine Islands.

SEC. 7. That this act shall not be construed to impair or affect any privilege guaranteed to Spanish ships and merchandise by the treaty of peace between the United States and Spain signed at the city of Paris on December 10, 1898, and ratified April 11, 1899.

SEC. 8. That the Secretary of Commerce and Labor shall, from time to time, issue regulations for the enforcement of this act, except as otherwise provided in section three: *Provided,* That such of the navigation laws of the United States as are in force in the Philippine archipelago in regard to vessels arriving in the Philippine Islands from the mainland territory and other insular possessions of the United States shall continue to be administered by the proper officials of the government of the Philippine Islands.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of May 9, 1904, the following degree of completion of vessels building for the United States Navy:

				Degree of Completion. Per Cent.	
BATTLESHIPS.				Apr. 1.	May 1.
Ohio	18 knots.	Union Iron Works		91	93
Virginia	19 "	Newport News Co		56.8	59.4
Nebraska	19 "	Moran Brothers Co		44.5	46.9
Georgia	19 "	Bath Iron Works		49.91	52
New Jersey	19 "	Fore River S. and E. Co		55.3	57.6
Rhode Island	19 "	Fore River S. and E. Co		57	59.8
Connecticut	18 "	Navy Yard, New York, N Y.		34.56	38.46
Louisiana	18 "	Newport News Co		44.27	47.91
Vermont	18 "	Fore River S. and E. Co		5.6	6.8
Kansas	18 "	New York Shipbuilding Co.		6.3	7.5
Minnesota	18 "	Newport News Co		21.65	26.15
Mississippi	17 "	Wm. Cramp and Sons		0.7	2.3
Idaho	17 "	Wm. Cramp and Sons		0.6	2.2
ARMORED CRUISERS.					
Pennsylvania	22 knots.	William Cramp and Sons		71.2	76.9
West Virginia	22 "	Newport News Co.		80.25	83.4
California	22 "	Union Iron Works		58	60
Colorado	22 "	William Cramp and Sons		77.5	80.9
Maryland	22 "	Newport News Co		75.88	78.88
South Dakota	22 "	Union Iron Works		54	55.5
Tennessee	22 "	William Cramp and Sons		23.4	28.9
Washington	22 "	New York S. B. Co		20.9	24.2
PROTECTED CRUISERS.					
Denver	17 knots.	Neafie and Levy		99	99.9
Des Moines	16½ "	Fore River S. and E. Co		100	
Chattanooga	16½ "	Lewis Nixon		75.71	80.01
Galveston	16½ "	Wm. R. Trigg Co		75	78
St. Louis	22 "	Neafie and Levy Co.		40.9	41.2
Milwaukee	22 "	Union Iron Works		46	48
Charleston	22 "	Newport News Co		67.2	69.7
GUNBOATS.					
Dubuque	12 knots.	Gas Engine and Power Co.		33.5	40
Paducah	12 "	Gas Engine and Power Co.		29.1	33.6
TRAINING SHIPS.					
Cumberland	Sails	Navy Yard, Boston		28.5	35
Intrepid	"	Navy Yard, Mare Island		12	16
TRAINING BRIG.					
Boxer	Sails	Navy Yard, Portsmouth		28	34
TORPEDO BOATS.					
Stringham	30 knots.	Harlan and Hollingsworth		93	93
Goldsborough	30 "	Wolff and Zwicker		99	99
Blakely	26 "	George Lawley and Son		99	99
Nicholson	26 "	Lewis Nixon		99	99
O'Brien	26 "	Lewis Nixon		98	98

NEW HUDSON RIVER STEAMBOAT C. W. MORSE.

STEAMBOAT C. W. MORSE, FOR THE HUDSON RIVER.

The steamer *C. W. Morse,* which has just been completed for the Peoples' line between New York and Albany, is one of the largest side-wheel steamboats afloat. The vessel was designed by Mr. J. W. Millard, naval architect, of New York. The *Morse* will be the running mate of the steamer *Adirondack,* built for this line eight years ago. While the new steamer is about 30 feet longer than the *Adirondack,* and resembles her in many respects, the hull up to main deck is built of steel, and, in place of the cumbersome hog frame, the fore-and-aft strength is secured by longitudinal girders worked in on either side of main deck on a line with the steel hull and wheel-battery bulkheads. Much space is gained by this change, and the boat presents a far more graceful appearance. The over-all length is 430 feet; the beam, molded, 50 feet 6 inches; over guards, 90 feet; and the depth, molded, 14 feet 6 inches. With such a shallow hull, where the ratio of breadth to depth is as high as 3.5 to 1, special consideration had to be given to fore-and-aft strength. The channel of the Hudson river at the upper end is not deep, therefore it is necessary that boats be of very light draft. The load draft of the *Morse* is but 9 feet, and it was necessary to keep the weights of scantling down to the very lightest consistent with strength. By referring to page 282 the reader will see the way in which the designer carried out this problem in the distribution of weight. The longitudinal girders, before referred to, take the greater part of this above main deck. Two lattice girders, six keelsons, and four side stringers, besides the usual plating and center keelson, take care of the strains below deck.

Another feature to be noticed is the truss for supporting the overhang of the guards. Rigid support is given by angle-iron trusses with deep-flanged brackets alternating with pipe stanchions; at the same time the sponsons clear the water line by 18 inches at the lowest point.

The hull was built by the Harlan & Hollingsworth Company, Wilmington, Del., the joiner work by C. M. Englis, and the engine and boilers were built and installed by the W. & A. Fletcher Company, Hoboken, N. J. No expense has been spared in her design and construction to make her as safe and comfortable as possible.

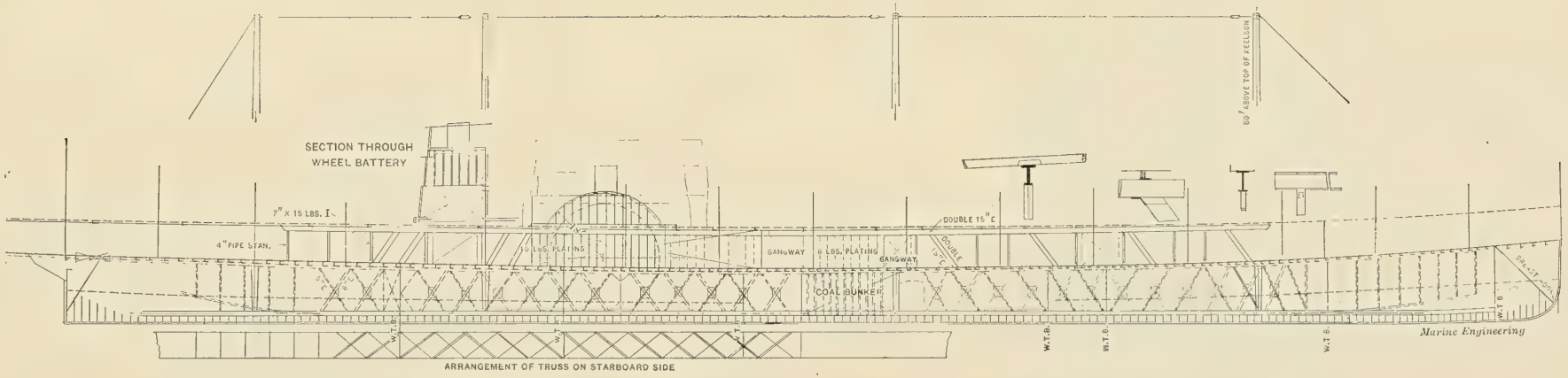
Some idea of the size of the vessel can be obtained by the statement that the area of all the deck is 135,000 square feet, or about three acres.

GENERAL ARRANGEMENT.

The hull is divided into eight water-tight compartments by seven thwartship steel bulkheads to main deck. A lower deck of wood extends fore and aft except in way of boiler rooms. Directly aft the forward collision bulkhead is a space 46 feet long devoted to the crew's quarters, accommodating 18 firemen and 18 deck hands. In the next compartment, which is 60 feet 6 inches long, are berths for men passengers who do not purchase state rooms. There are in all 116 berths. The dynamo room, 16 feet fore and aft by the full width of the vessel, comes next, and is located directly forward of the boilers. In this are placed three 50-Kw. General Electric direct-connected generators and switchboard. The two-wire system is used for distribution, the mains being laid in iron conduit, and there are in all 2,500 16-c. p. lamps through the cabins, etc. Current is also supplied to a 36-inch searchlight placed on the pilot house.

The boiler room is 83 feet fore and aft, and contains four lobster-back return-flue boilers placed fore and aft with the common fire room. Wing coal bunkers, with a capacity for 200 tons, are located on either side.

A space 50 feet fore and aft is devoted to main engine auxiliary machinery, and aft of this is a compartment 45 feet by 45 feet suitably divided for bar room, kitchen, and pantries, and sleeping quarters for employees in the



LONGITUDINAL ELEVATION SHOWING ARRANGEMENT OF FORE-AND-AFT GIRDERS ON THE SHALLOW-DRAFT STEAMBOAT C. W. MORSE.

steward's department. A wide stairway leads from the pantry to the dining room above for the use of the waiters. The bar room is entered through a stairway leading from the boot-black parlor. The remaining space aft is fitted up for sleeping accommodations for 66 women passengers and stewardesses on the port side, and 55 men passengers on the starboard side. Access to the women's cabin is by means of a stairway leading from the saloon and main decks.

Most of the space forward on the main deck is for the carrying of freight. The steam-steering gear is placed directly below the pilot house on this deck. At the bow there is windlass and space for the handling of lines, etc. Abreast the engine and boiler-room casings are store rooms and a pump room and the wheel batteries, that space alongside the engine casing being reserved for the baggage of passengers.

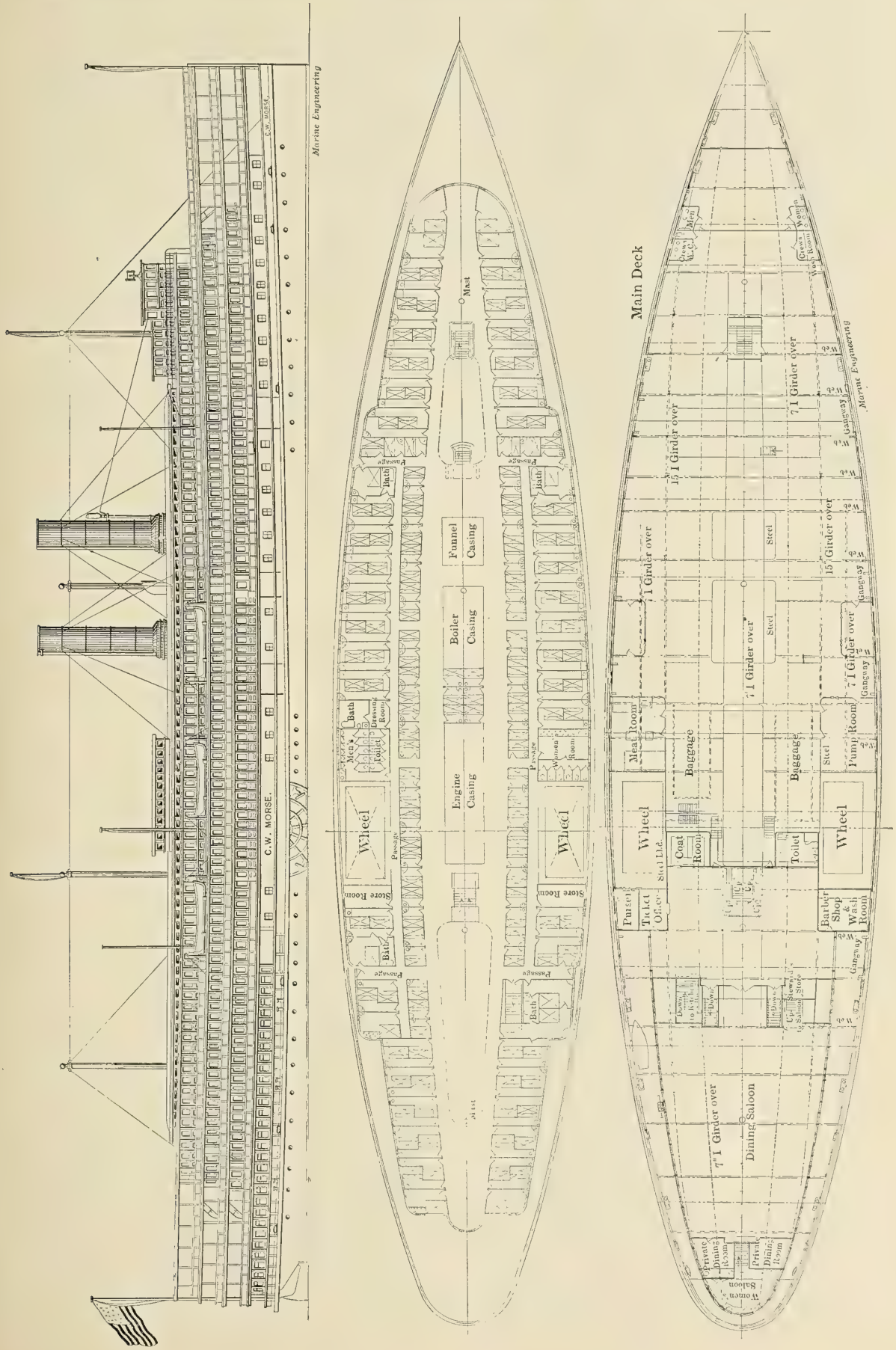
The after end of this deck is devoted entirely to an immense lobby and dining room. Gangways on either side open into this lobby or quarter deck, which is richly finished. Forward is a stairway of mahogany leading to the main saloon above, while directly opposite this is the dining saloon with large windows closely set around three sides. This dining room is 110 feet long and seats 300 people comfortably. There are in addition, at the after end of the main room, two handsomely-finished private dining rooms. The wood work is mahogany richly carved, and the ceiling in delicate white and gold. By night the room is illuminated by 225 electric lights mounted on bronze green fixtures. A promenade runs around the outside of the dining room.

Opening from the quarter deck are the purser's office, barber shop, wash room, coat room, etc. Ascending the main stairway the passenger finds himself in the grand saloon, extending almost the entire length of the steamer. It is here that he gets his first impression of the enormous size of the vessel. There is an unobstructed view to the dome on the top deck 28 feet above. There are two galleries with mahogany guard rails and green bronze grill work opening into the saloon, and on all decks state rooms are so arranged that there are very few inside rooms, and, in fact, none which are not freely ventilated. The color scheme is carried out in white and gold with a touch of green, with none of the over decoration and garishness often found on steamers.

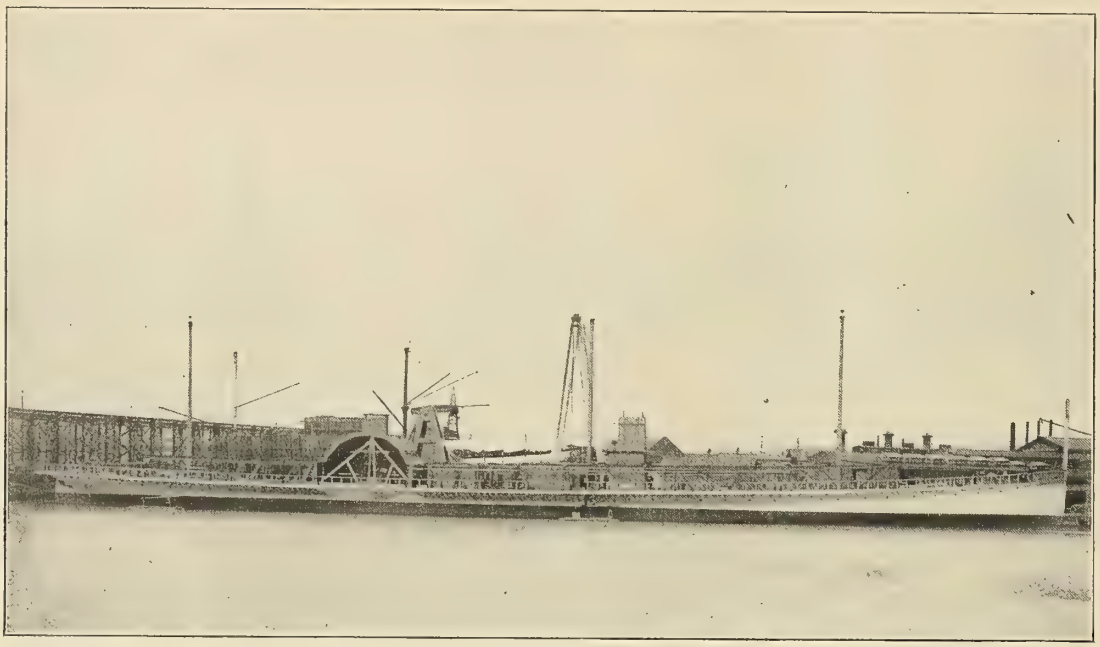
For about 125 feet amidships the state rooms run clear out to the side of the ship in line with the wheel battery. The outside panels of the wheel house and these state rooms are the same; that is, there is no break in the shear, thus keeping the whole side of the vessel symmetrical. The remainder of the cabins set back allowing ample room for promenade space. The feature aimed at has been to give most of the passengers outside rooms, and this is carried out in a manner as shown in the deck plans on page 281. The only inside rooms are those amidships, and these have windows on the outside opening into a broad, well-lighted corridor. From this corridor other rooms are entered. There are a number of cabin de luxe, with tapestried walls and ceilings in ivory and gold. These parlors are furnished with brass bedsteads and have private baths and toilets adjoining. There are also several bath rooms, for the use of passengers occupying rooms without attached baths. The passenger accommodations on this deck are: 14 large outside parlor rooms; 70 state rooms, 140 berths, outside rooms; 58 state rooms; 116 berths, inside rooms.

The gallery deck is arranged practically in the same manner as the saloon deck and has accommodations as follows: 12 large outside parlor rooms; 92 state rooms, 184 berths, outside rooms; 58 state rooms, 116 berths, inside rooms.

The upper gallery deck is somewhat differently arranged in that the cabins do not extend to the side of the boat but run in a continuous line all fore and aft,



PROFILE AND DECK PLANS OF THE NEW HUDSON RIVER STEAMBOAT C. W. MORSE.



STEEL HULL OF THE C. W. MORSE, READY TO BE TOWED FROM WILMINGTON, DEL., TO NEW YORK, FOR ENGINES AND JOINER WORK.

allowing an unobstructed promenade. Amidships on this deck are stowed the boats and life rafts. At the end is a large palm garden with café adjoining. The accommodations are: 84 outside state rooms, 168 beds, and 6 inside state rooms, 12 beds. Thus there are 402 rooms in all.

The dome deck extends the length of the upper gallery cabin inclosure and furnishes light and ventilation to the remainder of the boat. At the forward end is the pilot house and adjoining it are the quarters for captain and officers. The floor of the pilot house is about 40 feet above the water level.

The *Morse* has four steel masts 85 feet long by 24 inches diameter and two smoke stacks 6 feet 2 inches diameter and 95 feet 6 inches above the keel.

MACHINERY.

The main engine is a duplicate of the *Adirondack's,* of the simple vertical-beam surface-condensing type, built for 50-pounds pressure. The cylinder is 81 inches diameter and the stroke 12 feet. The paddle wheels are of the feathering type, built of steel, 30 feet outside diameter of buckets, with 12 buckets 12 feet 11 1-2 inches long. The shafts, which are overhung, are 24 inches diameter. When making 27 revolutions the engine will indicate 4,500 horse power, which is estimated will give a speed of 17 knots under favorable conditions. The air pump, direct-connected to the beam, is 47 inches diameter, and has a stroke of 51 inches. There are 6,153 square feet of cooling surface in the condenser. The total heating surface of the four boilers up to the water line is 9,000 square feet. Each boiler has superheating surface in the chimneys.

The boilers are four in number, arranged with axes fore and aft and opening into a common fire room. They are built for a pressure of 55 pounds and are 33

MARINE ENGINEERING DATA CARD. JUNE, 1904.

NAME—C. W. Morse. NATIONALITY—American. TYPE—River passenger steamboat.

LAUNCHED—1902. BUILDERS—Harland and Hollingsworth Co., W. and A. Fletcher Co. OWNER—People's Evening Line.

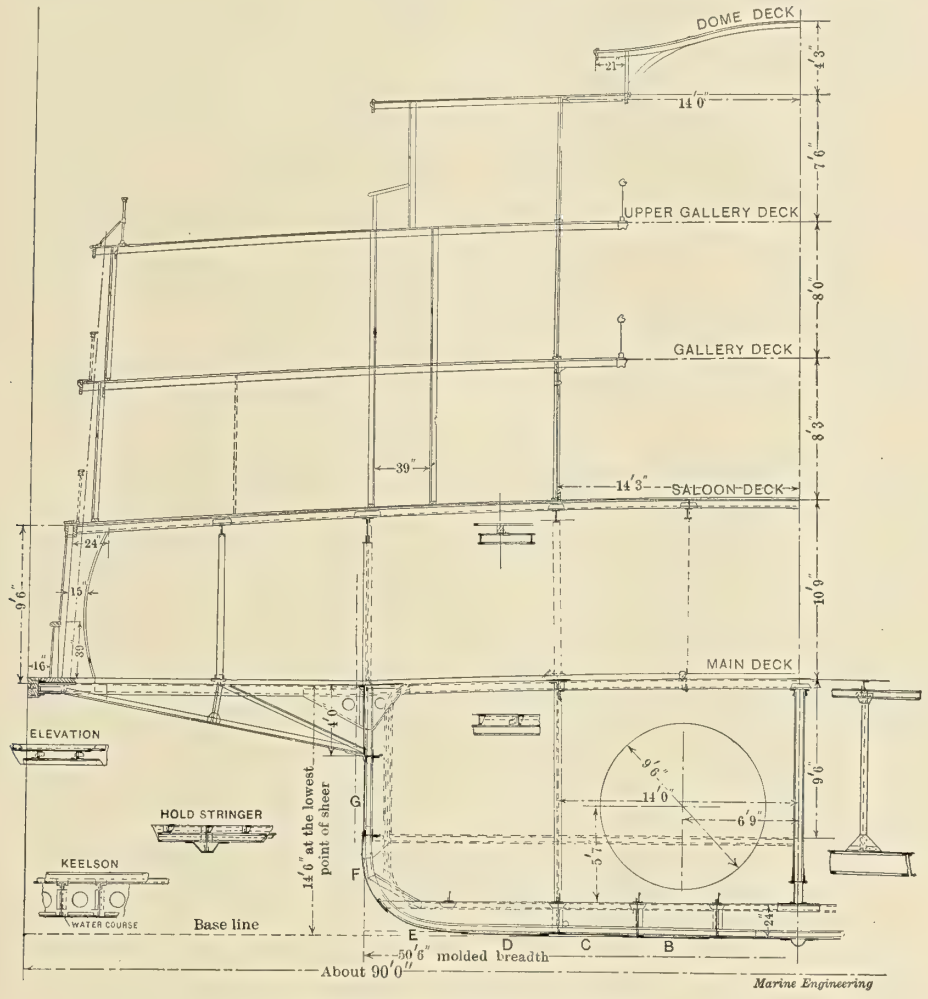
Length over all	430 ft. 0 ins.
" between perps	410 " 0 "
Beam, molded	50 " 6 "
" over guards	90 " 0 "
Depth, molded	14 " 6 "
Draft	9 " 0 "
Displacement	3,300 tons
Dead weight carrying capacity	1,000 "
Tonnage, gross	4,307 "
Engine: Type, walking beam paddle wheel	
Cylinder diameter	81 ins.
Stroke	12 ft.
Shafts, diameter	24 ins.
Air pump, diameter	47 "
" " stroke	4 ft. 3 ins.
Condenser tubes	3,346—3 4 ins O. D.
" " length	9 ft. 9 1-2 ins.
" cooling surface	6,153 sq. ft.
Wheels: Type, feathering buckets	
Diameter outside buckets	30 ft.
Buckets, length	12 ft. 11 1-2 ins.
" number	12
R. P. M., maximum	27
I. H. P., "	4,500
Speed, "	17 knots
Boilers: Number	4
Type	lobster back return flue
Length	33 ft. 0 ins.
Width at front	11 " 4 "
Diameter	9 " 6 "
G. S. 4 boilers	320 sq. ft.
H. S. to water line	9,000 " "
H. S. ÷ G. S.	28.1
H. S. ÷ I. H. P.	2.0
L. H. P. ÷ G. S.	14.1

feet long, 11 feet 4 inches wide across the fronts, and 9 feet 6 inches diameter. The steam chimneys on boilers are 7 feet 4 inches diameter by 10 feet 6 inches high. The boilers will be run ordinarily under natural draft, though, when necessary, forced draft may be used, as two blowers are provided to furnish air under the grates. The smoke boxes of the forward blowers lead to the forward stack and the smoke boxes from the after boilers to the after stack.

The vessel is classed under the United States Standard Register of Shipping.

The vessel is equipped throughout with electric bells, thermostatic push buttons, fire alarms, watchmen's clocks, and telephones for special service.

The complement of officers and men consist of, navigating department: captain, first and second pilot, two wheelsmen, and one lookout; engineer's department: chief engineer, two assistant engineers, four oilers, fifteen firemen; mates' department: first and second mate, two watchmen, fourteen deck hands, six deck boys; steward's department: steward, head waiter, chief cook, second and third cook, broiler, sink men, mess men, two



MIDSHIP SECTION STEAMBOAT C. W. MORSE.

The pumps, which are all of the Worthington pattern, are as follows:

Fire and wrecking, 1 duplex, 14 and 7 inches by 10 inches; 1 duplex, 16 and 17 inches by 10 inches.

Bilge, 1 admiralty, 7 1-2 and 6 inches by 6 inches.

Sanitary, 1 duplex, 7 1-2 and 4 1-2 inches by 10 inches.

Donkey boiler, 1 duplex, 4 1-2 and 2 3-4 by 4 inches.

There is one Worthington jet condenser for electric-lighting plant with a 14 and 12 inches by 10-inch pump.

A large donkey boiler is placed on main deck within the boiler inclosure. Special care has been taken to provide an effective fire system, there being 52 hose connections fitted on the four fire mains.

helpers, fireman, four pantry men, and fifty-two colored waiters, cashier, checker, barber, and bar tender.

OBITUARY.

John L. Weeks, treasurer and general manager of the American Steam Gauge and Valve Company, died suddenly in Boston on April 2, 1904, as the result of complications arising from an operation for appendicitis two years ago. Mr. Weeks was born in Akron, Ohio, thirty-eight years ago, and has been with the above-named company for fifteen years. He had a large acquaintance of friends throughout the country to whom his death is a great loss.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

OUR readers will remember the discussions which appeared in these columns and throughout the technical press on the possible and probable consequences of the Naval Personnel bill of March 3, 1899, in consequence of which the former Engineer Corps of the navy was abolished as a separate corps and its members were amalgamated with the line branch of the service. The experience of four years seems to indicate that at least some part of the fears which were then expressed regarding the measure were not without some foundation, and it is perhaps not going too far to say that on all hands and among those most vitally interested the results have been disappointing in respect to the maintenance of the engineering skill necessary for the proper care and efficient operation of the machinery of our modern fleets. The effects of a measure of this character will depend on two main features: the provisions of the measure itself and the way in which they are interpreted and carried out by those charged with authority in the matter. In the present case it may perhaps be said that the measure was, on the whole, better than its execution. While not free from radical and, perhaps, fundamental faults, yet these might in some measure have been counteracted, and the engineering necessities of the situation better safeguarded by an interpretation of the measure in more intelligent sympathy with these aspects of the naval service.

However, we are not now so much concerned with the past as with the future. It may be admitted that, under the present adminisration of existing legislation, the present and future engineering needs of the naval service are not being properly safeguarded. The former highly-trained corps are wasting by natural causes and no means are in operation looking toward the provision of men with equal training, or of counteracting such wastage by the development of equally good material in the lower grades of the service. This condition, which has been repeatedly urged upon the Secretary of the Navy and upon Congress by the late Engineer-in-Chief, Admiral Melville, and his successor, Admiral Rae, has at last attracted the serious attention of the Secretary of the Navy, and a board was appointed for the consideration and study of the entire subject, the especial purpose being to devise some means which shall make good the wastage in the specially-trained body of engineers, and provide a body of officers on whom full reliance may be placed with regard to the interests of this vitally important aspect of the naval service.

This board has recently submitted its report, and, according to the public press, its most important features are intended to provide for the more acute needs through departmental regulation and not involving the necessity of congressional legislation. This is certainly wise, for it would seem most unfortunate to involve these important interests in the uncertainties of new legislation in Congress, and possibly to awaken controversies which were happily quieted by the legislation of 1899.

It is not alone in relation to the design, operation, and maintenance of marine propulsive and auxiliary machinery that present conditions have been felt quite unsatisfactory, but in relation to our modern ordnance as well. The production of modern high-powered guns and ordnance material involves engineering of the highest type, and the whole field of such work becomes, in fact, a branch of engineering, and those who are qualified therein become, in fact, engineers. This is further evidenced by the terms ordnance engineering and ordnance engineer, which are becoming so widely used in reference to the production

of modern ordnance. Here, again, our present naval organization is lacking, furnishing no proper provision for adequately-trained ordnance engineers, and no assurance that our modern guns and ordnance material can be kept up to or ahead of the front rank of the world's progress.

With these needs in view and upon the recommendation of this board, the Secretary of the Navy has recently directed that two junior lieutenants, four ensigns, and four midshipmen just completing their six years' course, shall be assigned to ordnance duty exclusively, and the same number of each grade to engineering duty exclusively. These assignments are to be made at once, and each year hereafter four midshipmen completing the six years' course are to be similarly assigned exclusively to ordnance duty and four to engineering duty. The officers thus assigned are to retain their positions in the line and those doing ordnance duty will also perform line duty at sea. The officers assigned to engineering duty exclusively will, on the other hand, not perform line duty at sea, and, as a compensation for not being able to enjoy the distinction which attaches to the duties of command rank at sea, it is provided that after attaining command rank they shall be assigned exclusively to shore duty.

The effect of carrying out these recommendations will be to create a new ordnance corps and a new corps of naval engineers, without depriving the officers of actual rank and title, and by means of a simple restriction in the character of the duty to which the officers in question are assigned.

There are other features in the report, reference to which lack of space prevents, and in particular with refeence to the education and training by means of which the officers thus specially assigned are intended to be prepared for their important duties. The significant point, however, lies in the fact that a move has been made. This implies a realization of the needs of the situation and a disposition to take such remedial measures as the most careful study can suggest. The question may naturally arise whether the special assignment of only four officers each year exclusively to engineering duty will prove adequate to the needs of the situation. Certainly it will give no more than a sprinkling here and there of such specially-trained men of any one grade or for any one type of duty; but this is better than the condition in the past, and the number may later be increased as experience demonstrates the need. The step is certainly one of the utmost potential importance and value, and if it is only carried out with a view of realizing its full possibilities it cannot but prove of the greatest value as a factor in maintaining our navy in a condition of the highest possible engineering efficiency.

AS we are going to press the first meeting of the Merchant Marine Commission is about to hold in New York city its first public hearing. In lieu of any legislation protecting American shipping generally this commission was appointed to "investigate and to report on the opening day of the next session of Congress what legislation, if any, is desirable for the development of the American merchant marine and American commerce, and also what change or changes, if any, should be made in existing laws relating to the treatment, comfort, and safety of seamen in order to make more attractive the seafaring calling in the American merchant marine." The commission is composed of five senators, five representatives, and an able secretary, and is subdivided into three committees, one to investigate specially into conditions on the Atlantic seaboard, another into the affairs on the Great Lakes, and a third committee will proceed to the Pacific. It is unnecessary to bring evidence before this commission that American shipping and shipbuilding is in a deplorable condition. The facts in the case are evident to any layman; the public hearings are for the purpose of finding out some specific practical way of averting the decline and building up these industries. From all indications the most practical way to accomplish this end appears to be through discriminating duties. The fate of several subsidy bills in Congress is proof that such a bill can never be passed. For all interested to unite on one feasible plan, and that one which offers the least resistance, is the only way in which to secure the desired legislation.

In other ways Congress has done considerable for American shipping. Elsewhere in these pages are given three bills passed to increase the commerce to be carried in American bottoms and to American ports. Carrying government supplies in American ships will bring many large ships into active service, and the extension of the shipping laws to the Philippines will create a demand for our vessels in the transpacific trade. The outlook on the Pacific is promising, but unless some general shipping legislation such as it is hoped the Merchant Marine Commission will recommend is passed, the deep-sea Atlantic trade must continue to pass into foreign hands.

Grounding and Repair of Steamer Franconia.

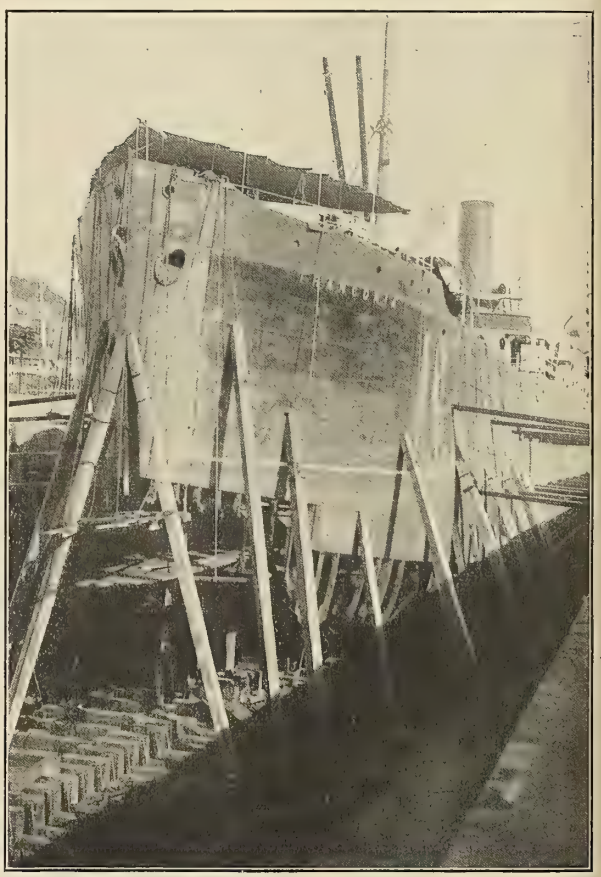
On the night of June 9, 1903, the Austrian steamer *Franconia,* laden with 7,000 tons of grain, bound from Odessa to Rotterdam, was carried ashore by a strong current off the Algerian coast, and struck on a submerged ledge named the Two Sisters. The lifeboat was at once lowered and part of the crew started for the port of Bona, which they reached safely; Captain Radonicic and the chief engineer, with a few of the crew, stayed on board. An examination of the damage showed that the bow of the vessel had been badly crushed in and the inner and outer plating of the bottom was bent up as far aft as No. 2 water-tight bulkhead. A bad sea and rough weather on the following day opened up the bottom still wider, and practically the entire cargo in the forward hold dropped through; this resulted in raising the forebody up to such an extent that the vessel was floated from the rocks on the second day.

AUSTRIAN STEAMER FRANCONIA AFLOAT AFTER GROUNDING.

Then the crew discharged the cargo of wood that was placed on deck, started up the engines, and proceeded slowly to Bona, where they arrived on the morning of June 11. Hold No. 1 was full of water, with 3 feet of water over No. 1 'tween-decks. Sounding showed that there was 6 feet of water at the forward end of No. 2 and 2 feet at the after end. The ship was then drawing 33 feet forward and 22 feet aft. At Bona 6,000 tons of cargo were discharged, and also 500 tons of ballast were lifted from the forward to the after end, and on July 12 the *Franconia* started for Genoa, arriving there four days afterward. After divers had examined the wrecked bow the *Franconia* was soon drydocked for reconstruction at the works of the Società Evercizis Barcini. A complete survey showed that the double bottom and the frames to a point above the water line and as far aft as No. 2 bulkhead had been carried away or were badly damaged and the stanchions badly bent. The stem, frames, and stringers round the damaged portion were cut out, and new ones fitted in and securely riveted.

The *Franconia* was launched from the Northumberland yard in February, and has the following principal dimensions: length, 360 feet; beam, 48 feet; depth. 30 feet 10 inches.

DAGNINO ATTILIO.



STEAMER FRANCONIA IN DRY DOCK, SHOWING DAMAGE TO THE FOREBODY.

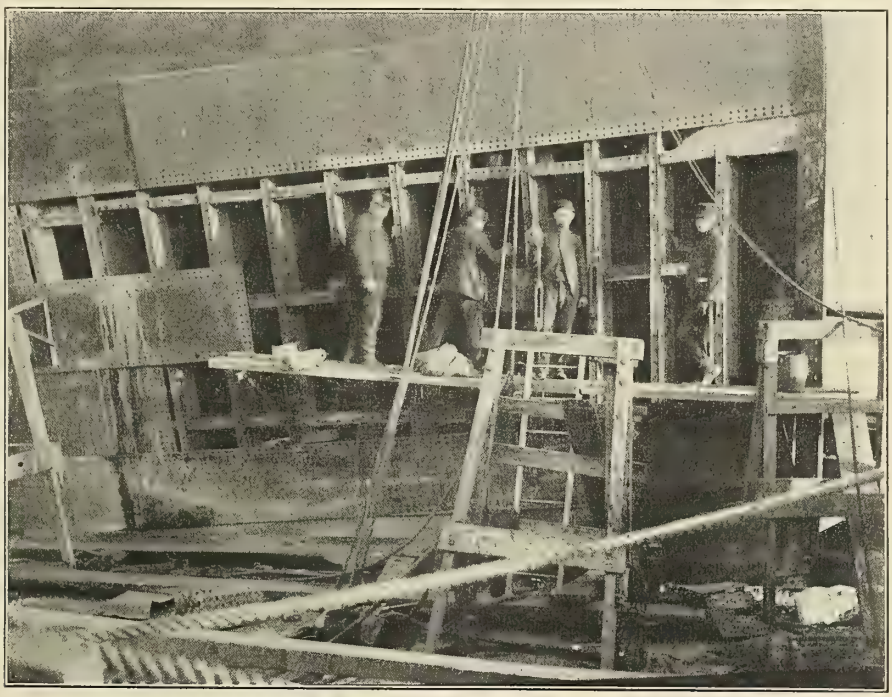
Repairs to the Steamer Denver.

An interesting case, and one showing that the port of New York is equipped with shipyards capable of carrying out quick repair work, is that of the repairs to the steamer *Denver,* of the New York and Texas Steamship Company. This fine steamer, while running on its regular route from New York to Galveston, went into collision with the Norwegian sailing vessel, *Araby Maid,* an iron barque, 194 feet in length and of 873 gross tons, built by R. Steele, of Greenock, Scotland, in the year 1868. The collision took place some thirty-three miles off Tortugas Light, on the southwest coast of Florida, about 8 o'clock at night. The *Araby Maid* was almost cut in two, but fortunately no lives were lost.

Very little apparent damage was done to the *Denver,* which continued its voyage. Upon arrival in New York, investigation showed that many of the bow plates on starboard side in the neighborhood of 10-foot water line,

together with a few frames and stringer angles, had been buckled and dented, so after cargo was discharged the vessel was sent to the yard of the Townsend-Downey Shipbuilding Company, of Shooter Island, N. Y., for necessary repairs.

The work of taking off the plates commenced on Monday morning, March 14, when it was found that fourteen plates (two below the water line) would have to be renewed or faired, two frames cut out and renewed and twelve frames straightened in place, besides sundry stringer angles. To get at the plates below the water line, the vessel was trimmed sufficiently by the stern, by filling the after peak and doublebottom tanks below shaft tunnel with some 89 tons of water. Four of the shell plates affected had to be renewed and the remainder straightened, and, notwithstanding the handicap of one



REPAIRING PLATES ON THE BOW OF THE DENVER.

day of snow, two days of rain and a Sunday, the contractors creditably performed their agreement in having this vessel complete and ready for handing over to the owners by the 23d of March, or 10 calendar days.

The low-pressure slide valve having given trouble for some time, advantage was taken of the laying up of the vessel to draw this valve, when it was found cracked extensively at bottom. Holes were drilled in the vicinity of the cracks and five fine threaded stay bolts were put in and riveted over; over these were put two cast brass patches, each about 18 inches long and 9 or 10 inches wide, one inside and the other outside, securely through bolted and clinched. The valve was then taken to machine and the faces planed, and is to-day as good as new.

The *Denver* was launched in 1901, at the Harlan & Hollingsworth Company, is of the awning-deck type and classed by Lloyd's Register. A description of this ship was given in Marine Engineering, in the issue of September, 1901.

The American Automobile Association Takes Control of Speed-Launch Racing.

One of the most significant steps in the history of American motor-boat sport was taken on Tuesday, April 5, when the American Automobile Association, through its racing board, assumed formal control of the racing of "strictly high-speed motor boats," frequently called automobile boats. This step was taken in response to a very general demand among individual owners of these fast boats, owing to the fact that the measurement rule and time allowance system of the American Power Boat Association, although admitted to be quite satisfactory for ordinary or cruising boats, gives unsatisfactory results when applied to boats of shallow draft and extreme power. The new classification of the A. A. A. was prepared by the technical advisers of the special motor-boat committee, appointed to consider the subject of possible affiliation with the A. P. B. A. These gentlemen, Lieut. Charles H. Hall of the naval militia, and H. L. Towle, reported that the measurement rule referred to credited the fast boats with higher speed than they were able to make, owing, apparently, to the relatively large wetted surface of these boats. They were, therefore, asked to submit a new classification, which was accepted by the racing board. In this classification the time allowance system is discarded, it being considered that too little is known at the present time about the actual speed of high-power boats to justify such a system. In its place is substituted a classification based on the load water line length, with restrictions as to beam and horse power. The latter is calculated solely on the basis of the total piston-head area, on which the actual restriction is laid, and the builder is left free to obtain as high piston speed and as light weight as he can. The most recent constructions

in the way of speed boats seem to indicate that the limits have been placed about as high as possible, and that several seasons may elapse before builders learn to utilize such extreme powers to advantage.

The total classification is as follows:

Class.	Maximum L. W. L.	Minimum W. L. Beam.	Rated H. P.	Piston Head Area, 4-cycle Engine.	P. H. A., 2-cycle Engine.
A.....	26 ft.	3 ft. 9 ins.	30	60 sq. ins.	45 sq. ins.
B.....	32 "	4 " 2 "	50	100 " "	75 " "
C.....	40 "	4 " 9 "	90	180 " "	135 " "
D.....	50 "	5 " 6 "	180	360 " "	270 " "
E.....	65 "	6 " 6 "	400	800 " "	600 " "

In addition there is an "A. A. A. Special" class for boats with hulls not over 40 feet long over all, beam and horse power being unrestricted. This class is designed to bring out a line of boats eligible to compete for the Harmsworth international challenge cup.

A short calculation will show that for a 4-cycle engine the nominal horse power, under the above rating, is based on an assumed M. E. P. of 66 pounds per square inch net, after deducting internal friction, and on a piston speed of 1,000 feet per minute. For the 2-cycle engines the net M. E. P. is assumed to be 44 pounds per square inch and the piston speed 1,000 feet. These figures of M. E. P. and piston speeds are somewhat below what has been found possible in automobile motors, but the piston speed is considerably higher than has been attempted in marine motors until quite recently. Evidently the result of these rules will be to stimulate the development of the high speed and light-weight motor to a point where it will rival the automobile motor. Obviously, unless the engine is not only powerful but very light, it will be impossible to put so large a power into such small boats.

A perusal of the general rules for motor-boat racing, adopted at the same time, shows that it is not the intention of the A. A. A. to enter into a contest with the American Power Boat Association, since it will issue sanctions to any responsible clubs or individuals and will not attempt to prevent those competing under its rules from competing also under the A. P. B. A. rules. It will register and measure any boat on request of the owner and payment of a fee.

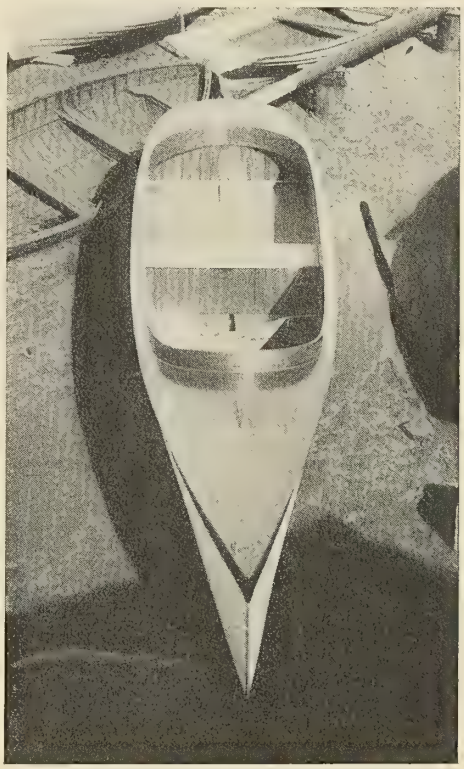
A feature of the hull measurement rule, which is not found in the A. P. B. A. rule, is that boats whose sterns have flattened under sides are measured to the extreme after end of the fair lines of the under body, it being assumed that the stern will settle down to these lines when the boat is under way. The boat may be measured with empty tanks.

The rules for equipment require that every boat shall have a reversing gear and shall carry at least one serviceable anchor weighing 1-2 pound per foot of load water line, and 10 fathoms of manila cable; also one pair of oar locks and oars, and shall be equipped with fog signal and the necessary lights required by law. The boat shall also carry as many life buoys as the total number of persons on board.

The time of the race is to be taken from the limit gun, with no allowance for delay in getting across the starting line. An overtaking boat must allow at least 20 feet of clear water between herself and the overtaken boat. Considering that the speed of these boats will be from 20 to 30 miles an hour, this clearance, which is double that called for by the A. P. B. A. rules, certainly does not seem too much.

Provision is made for challenge races, for which the forfeit fee is $100, to be given, half to the challenged parties and the other half to the A. A. A., in case the challenger fails to appear. Challenge races, like all others, contemplate boat for boat, without time allowance. Another section provides for the making of record and time distance trials under proper safeguards to insure their authenticity.

The motor-boat committee of the A. A. A., by which the foregoing rules were drafted, consists of A. R. Pardington, of the Long Island Automobile Club, Chairman; W. K. Vanderbilt, Jr., and Louis R. Adams, L. I. A. C.

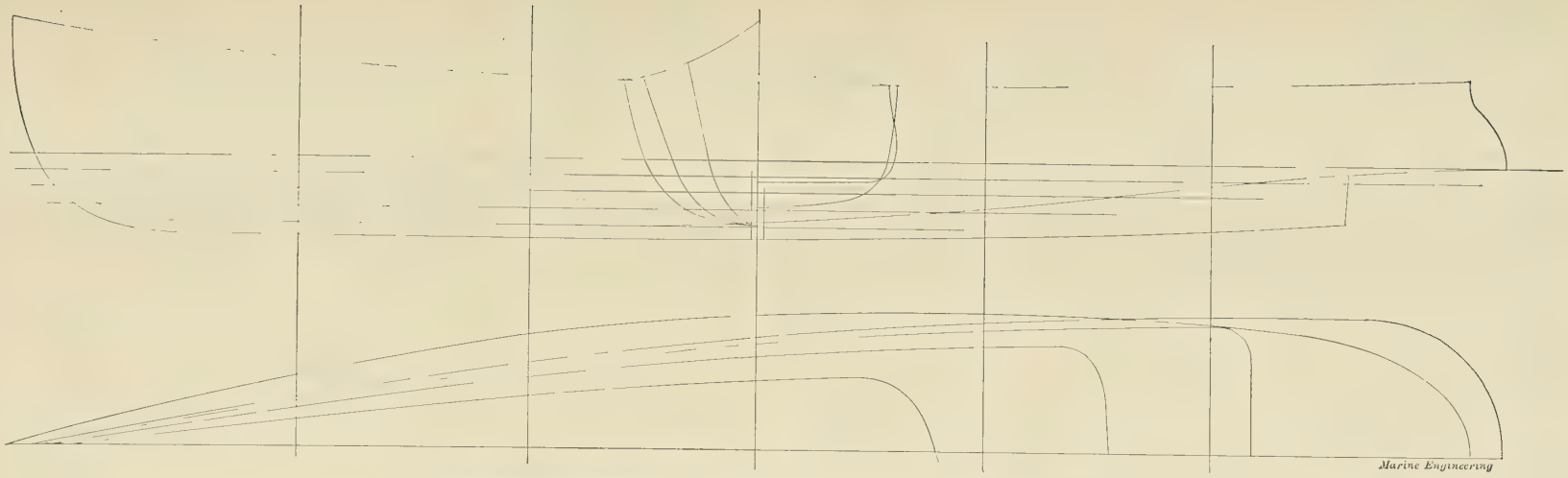


FAST TWENTY-TWO-FOOT MOTOR LAUNCH.

Twenty-two-Foot Launch.

The accompanying water lines and engraving are of a power launch built by the Dutton Engineering Company, Perth Amboy, N. J., for Mr. Warren Cowles, of Peoria, Ill. The launch is 22 feet long over all, 4 feet beam. It was designed primarily as a pleasure boat and incidentally to develop moderately fast speed. The principal novelty is in placing the engine forward of the steersman and in connecting the propeller shaft to the fly wheel end of the engine shaft, so that the steering and engine adjustments are conveniently at hand for the operator when facing the bow. The launch is not intended to carry many passengers and so the lines have been made very fine forward.

As the launch will be used principally on a small



LINES OF 22-FOOT MOTOR LAUNCH BUILT BY THE DUTTON ENGINEERING COMPANY.

western lake, a depth of 36 inches at the bow and 26 inches midships was deemed sufficient for safety. No attempt is made for extreme lightness. The frames are 3-4- by 1-inch oak, steam bent; the planking of solid white cedar 5-8 inch thick; the plank shear, shear strake, and coaming of quartered oak. The deck is laid with white pine in narrow strips, blind nailed. While intended for fresh water the hull is copper fastened throughout and finished in every way as for salt water.

The motor consists of a 2-cylinder, standard Dutton engine developing about 7 horse power at 700 revolutions per minute.

Position of Civil Engineer.—The United States Civil Service Commission announces an examination to be held on June 8, 1904, at the principal cities of the country to secure eligibles from which to make certification to fill the vacancy in the position of civil engineer, Bureau of Forestry, Philippine service, at $2,400 per annum. Full particulars may be had upon applying to the commission at an early date.

Engineering Building.

As a result of Mr. Andrew Carnegie's gift of $1,000,000, to be used in the erection of a suitable building in New York city to contain the libraries, assembly halls, offices, and meeting rooms of the four leading engineering societies, a committee composed of three members of each organization has been appointed to obtain competitive plans and specifications for the new building. The engineering societies are the American Society of Mechanical Engineers, American Institute of Electrical Engineers, the American Institute of Mining Engineers, and the Engineers' Club. The committee has been advised by six architects that they will submit designs in this competition, and it is agreed that the committee will pay to each of these architects the sum of $1,000 as compensation. If one of these six architects be the successful competitor the $1,000 reward paid will be considered as credit on his commission. Plans from other representative architects will also be received and four prizes of $400 each will be awarded for the best designs from these outside architects.

There will be two buildings, one the Engineering Building, with a frontage of 125 feet on the north side of West 39th street and a depth of 98 feet 9 inches, and the other building, the Engineers' Club, on the south side of 40th street, 50 feet frontage by 98 feet 9 inches depth. The backs of the two properties adjoin. The Engineering Building covers, exclusive of the 15 per cent. open space reserved under the city ordnances, about 10,500 square feet. At the top of the building will be three stories (possibly four), presumably similar, to be held for the use of technical, scientific, and engineering societies, who may hereafter be invited to make use of them. Below these will be three floors for the accommodation of the offices and other rooms, exclusive of auditoriums and libraries for the three engineering societies, each of which will reserve a floor for its own uses, and needs at present a minimum space something over 5,000 square feet, to be used for reception room, editorial and counting rooms, secretary's office, office of the staff, etc.

Additional accommodations for the storage of publi-

cations and other documents requires to be a feature of the basement parts of the building. On the top floor or in the roof spaces should be accommodations for the janitor and his family, and a room appropriate for the making of large-scale diagrams, photographic enlargements, and similar work in connection with the illustration of papers for public, scientific meetings.

There shall be provision for a library containing at the outset the combined collections of the three societies, comprising about 50,000 volumes; but accommodations should be made for six or eight times that number of volumes. Besides the open space for reading room and for writing, there must accordingly be space provided for book stacks. The committee will also consider a plan which shall place the library reading room at the top of the building, with a floor below reserved for book stacks.

Below the offices and the library there will be a series of lecture rooms or auditoriums varying in size. The largest, which will have a gallery, should accommodate 1,000 on the floor, and half as many additional in the gallery. Six others, some of which may be in a mezzanine, should vary in size, holding about 400, 250, 200, and 100, more or less, and may well be arranged in pairs with a movable partition between them, so that two may be thrown together on occasion. It may be convenient to have the large room so placed that the lower floor may come nearly on the level with the street. Adjoining the large room should be an adequate assembly and smoking room for informal meeting and conversation. It may, on occasion, be used for collations or dinners, which may be served by caterers from outside.

The floor on the street level should be appropriated mainly to administrative uses. Near the main entrance should be three ample coat rooms aggregating 2,200 square feet, capable of taking care of 1,500 persons at once, and a convenient ladies' dressing room. Near the entrance should also be a bureau of information, in which should be the telegraph and telephone offices, the post office, a sales department for the distributing of the publications of the societies, together with shipping and receiving offices for books, publications, and other packages coming into the building and leaving it.

Ample toilet rooms should be provided on the street level, near the large auditorium, and also in every part of the building.

In the sub-basement or cellar should be put the heating, ventilating, and lighting plant, which would occupy about 3,600 square feet. The boilers will require about 2,000 square feet, the machinery and tanks about 1,600. It is the purpose of the owners to have the auditoriums mechanically ventilated and provision for the ventilating machinery should be ample. Spaces otherwise unavailable in the basement can be valuably used for the storage of transactions, publications, and the like. The basement and sub-basement stories should be about 14 feet high each.

In the auditoriums, at the lecture tables of the important rooms, there should be furnished gas, water, compressed air, and electrical current, and the necessary drainage connections, in order that experiments, illustrations, and demonstrations may conveniently be made in connection with scientific lectures. Sufficient elevator service is to be arranged for.

There is to be convenient communication between the Engineering Building and the Engineer's Club building, about on the level of the first floor and street level, and another by a bridge on the level with the breakfast-room floor.

The above specifications as to the utilization of the various floors and the approximate sizes of the various rooms, may be changed at the option of the competitor, if, in his opinion, it is desirable or necessary to do so, in order to conform to the requirements of his general design.

The Engineers' Club will be eleven stories high with an addition of half a story in the rear for kitchen. In the sub-basement will be the boiler and engine rooms, elevator machinery, etc.; in the basement, the store rooms, barber shop, toilets, etc. On the main floor will be reception room, a large café, an office, coat rooms, telephone booth, etc. The floor above is devoted entirely to a large club room and a library. On the third floor most of the space is to be taken up by a billiard room, and the remaining by committee rooms and a card room. Six floors above will be arranged with about ten bed rooms on a floor, single and in suit, with baths, for the accommodation of members. One floor will be devoted to a breakfast room, another to a dining room, while on the roof will be the kitchen, store rooms, attendants' quarters, etc. Two passenger elevators run from the basement to the eleventh floor.

The secretary of the committee is Professor F. R. Hutton, 12 West 31st street, New York, N. Y.

LAUNCHES.

Steel Freighter R. W. England.—On May 6 the freight steamer *R. W. England* was successfully launched at the yards of the Great Lakes Engineering Company, at Detroit, Mich. This is the first steamer to be launched by this company. The *England's* dimensions are: length over all, 378 feet; beam, 50 feet; depth, 28 feet. She will have a carrying capacity of 5,700 tons of iron ore, or 6,000 tons of coal, and can store about 200,000 bushels of grain in her hold.

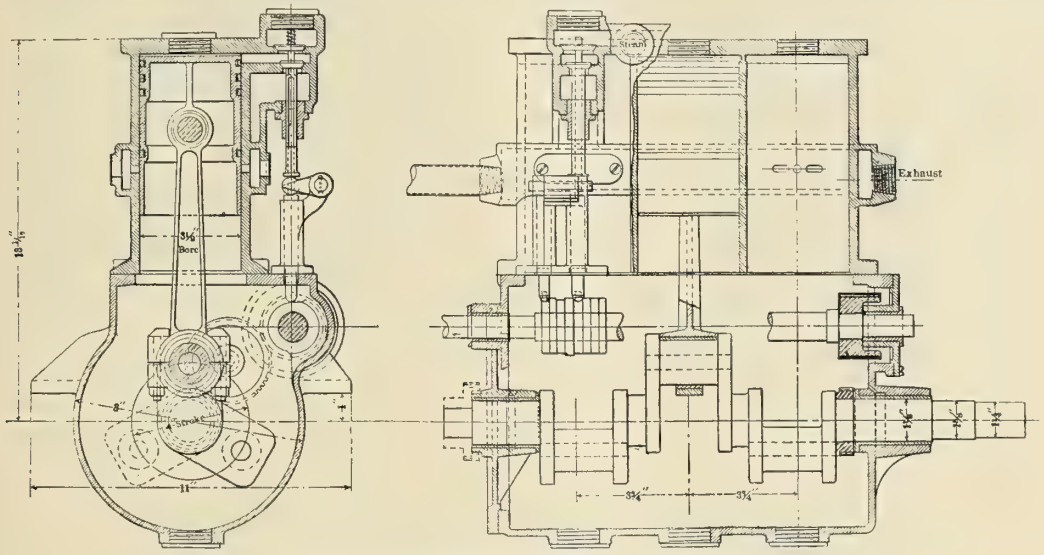
Steamer Sahara.—On May 5 the second largest carrier on the Great Lakes was launched by the American Shipbuilding Company from the Lorain yard, for Mr. G. A. Tomlinson, of Duluth. The ship is 494 feet over all, 474 feet on the keel, 52 feet beam, 29 feet deep, with a 5-foot water bottom. Arched girder plates, running athwartship between the hatches to web frames, are substituted for stanchions. The triple expansion engine has cylinders 22 1-2, 36, and 60 inches diameter by 42 inches stroke, and is supplied by steam from two Scotch boilers, 13 feet 9 inches diameter by 11 feet 6 inches, equipped with Ellis & Eaves draft. The keel of the *Sahara* was laid on March 1.

Armored Cruiser California.—On April 28 the United States armored cruiser *California*, building at the Union Iron Works, San Francisco, was successfully launched. A few particulars of this launching will be given in next month's issue.

ENGINEERING SPECIALTIES.

Three-Cylinder Steam Engine.

A new three-cylinder, single-acting steam engine, for automobile, launch, and stationary use, where high speed and light weight are desired, has recently been placed on the market by the Dieter Steam Engine Company, 113 Liberty street, New York, N. Y. The intention of the designers was to produce an engine of simple construction, where the valve setting would not require fine adjustment, and in which worn parts are accessible and may be readily taken out.



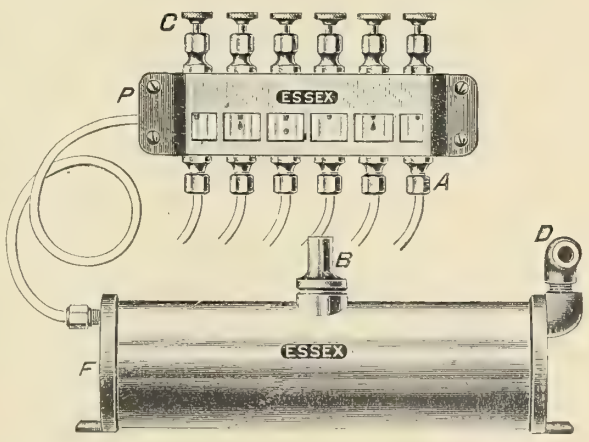
THE DIETER THREE-CYLINDER HIGH-SPEED STEAM ENGINE.

Referring to the illustration, it will be seen that the three cylinders and their respective valves are in one casting and mounted on top of the crank case. A cam shaft runs above and parallel to the main shaft and is driven by gearing from the latter. Poppet valves are used, one for the steam and one for the exhaust, the latter set on a sleeve of the steam-valve stem. Each is operated by its own cam lever. The cam shaft has a certain amount of end movement by means of which any one of four cams may be brought opposite each cam lever, thereby giving three different points of cut-off for ahead and one for stern motion. The valves open wide at the admission of steam and remain so until the cut-off takes place, thus preventing wire drawing. The clearances are very small, thus reducing steam consumption. The engine is run at a high speed and has shown large power per unit of space by working tests.

The exhaust chamber runs along the front of the engine at a height above the middle of the cylinder and is so arranged that it will serve as a muffler and will not permit of clogging of the parts from condensation. Steam and exhaust ports are adjacent to each other and communicate with the cylinder through a common passage and the valves do not require packing against the boiler pressure. No lubrication of the valves is necessary, while the cylinders are oiled automatically from the crank pits, thus doing away with the necessity of using oil cups.

Automatic Multifeed Oiler.

The illustration below shows the Essex automatic multifeed oiler for hydrocarbon engines. One of the troubles experienced with such engines is that of securing a positive and regular supply of oil to the various moving parts. The type of oiler here illustrated is made with any number of feeds and with any size reservoir, which is shown at the bottom of the engraving. Each connection at *A* leads to one bearing and the flow of oil through each pipe may be accurately adjusted by means of the valves *C* and the sight glasses. When once adjusted all the attention necessary is to fill the reservoir with oil occasionally. *B* is a filler plug in the reservoir, *D* is the point where connection is made to the crank so as to obtain the pressure for operating lubricator to supply oil to the distributor.



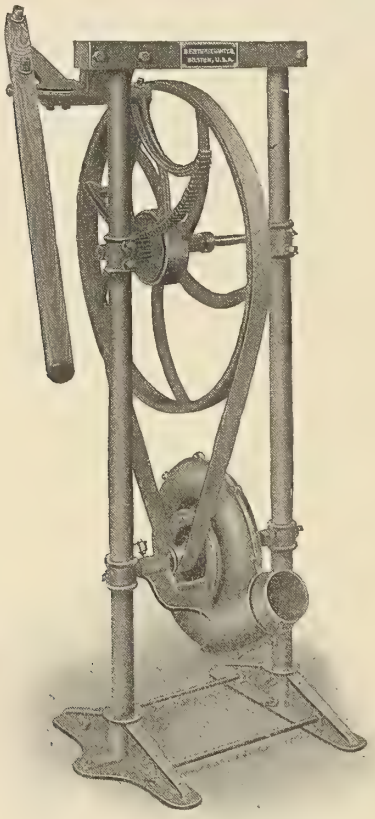
CONTINUOUS-FEED MULTIPLE OILER.

The manufacturer, the G. B. Essex Brass Company, 480 Franklin street, Detroit, Mich., also make a complete line of cylinder lubrication and grease cups for marine and gasoline engines.

Improved Hand Blower.

Hand blowers have been extensively introduced in connection with forges of all kinds, from the old-style brick to the modern iron forge, as they are efficient and economical substitutes for bellows. Another use of the forge is for portable ventilating apparatus. The design here illustrated is simple, strong, rigid, and compact, and is claimed to be economical in operation and readily portable. The running gear is simple and strong.

The blower is adjustable on the shaft and its outlet may thus be set to discharge in any direction and readily connected to the forge tuyere by means of galvanized

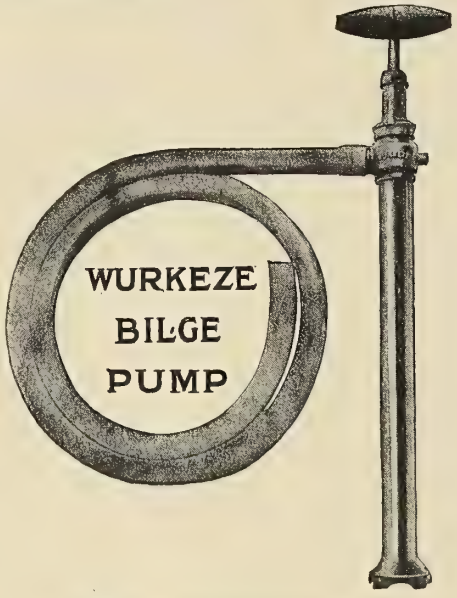


PORTABLE HAND BLOWER.

iron piping. The blower is of cast iron strongly constructed in every particular, has a steel shaft running in babbitted boxes, and a fan wheel of galvanized steel solidly riveted to a composition hub with extending arms. The frame is carefully designed, well braced, and is so arranged that the slackness of the belt driving the blower may be taken up by lowering the blower shaft, which is supported by collars sliding on the frame. The feet are provided with holes so that the hand blower may be readily screwed to the floor.

These hand blowers are made by the B. F. Sturtevant Company, Boston, Mass., in all sizes. The total length on the floor of Style B-1 is 18 inches, while the total height of the frame, not including the handle, is 48 inches. The driving wheel is 24 inches in diameter, the blower outlet is 3 1-2 inches in diameter, and the complete outfit weighs but 135 pounds.

Style B-2 is of slightly larger dimensions and has proportionately greater capacity for delivering air. The driving wheel is 24 inches in diameter, the blower outlet is 4 3-4 inches in diameter, and the complete outfit weighs 155 pounds.



BILGE PUMP SUITABLE FOR SMALL BOATS.

Portable Bilge Pump.

A small, handy bilge pump has recently been placed on the market by the Marine Hardware Company, Peabody, Mass., designed specially for launch and small yacht owners. It is made of brass throughout and so cannot rust. It is easy to operate and not liable to break down, as the mechanism is strong and very simple. The pump is made in two sizes, with a capacity of 6 or 12 gallons.

James Watt Memorial.

The following letter is being sent to the American engineers in behalf of a memorial to James Watt:

"A memorial statue is about to be erected in Greenock, Scotland, on the site of the humble cottage in which James Watt was born. For this purpose subscriptions of small amounts are being solicited in many countries, as it is felt that the memorial should represent the contributions of the thousands who know and appreciate what the invention of the steam engine has meant to the material progress of the world.

"Should you desire to associate yourself with this movement, kindly send any number of dollars, not exceeding five, and accompany the contribution with your autograph on the enclosed slip. The latter is desired for transmission to Greenock, to show the number of the American contributions.

"Our country has, probably, been the greatest beneficiary of Watt's labors, and the committee hopes that the response from the United States will exceed that of any other country in point of numbers, as the number of subscribers is a greater tribute than the amount subscribed. The committee is composed of the presidents of the American engineering societies.

"ANDREW CARNEGIE, Chairman."

QUERIES AND ANSWERS.

Q. 197.—Please answer through your Q. and A. column if there is any rule for the staying power of plain rolled tubes.

The boilers of S. S. *Sprague*, for instance, in your September number. Head's stayed top and bottom depending on the tubes in centre. Scotch boiler they are stay tubes put in by this rule if not mistaken allowing for the bore of tube that is not exposed to boiler pressure.

$$\frac{C \times (\text{thickness in 1-16 inch})^2}{\text{Boiler pressure}} = \sqrt{\text{Area}} = \text{Pitch.}$$

Also how do you get the strength necessary to resist collapsing pressure on the circular bottom of a combustion chamber box Scotch boiler? T. R.

A.—The formula above quoted equals *area* and not square root of area, and pitch. There is no satisfactory formula for the staying power of a plain rolled tube. Where stay tubes are fitted they may be spaced and fitted in accordance with the following formula:

$$\frac{200 \times (t-1)^2}{p} = A.$$

Where t = thickness in 16ths.
p = pressure allowed.
A = area supported by one stay tube, or,
A = product of the two pitches at which stay tubes are placed.

Thus, for example, $p = 160$, $t = 3\text{-}4$ inch.
Then $t = 12\text{-}16$ and we have:

$$A = \frac{200 \times (12-1)^2}{160} = 151.$$

This would correspond to a spacing of about 12 by 12, or 12 by 12 1-2 inches, for the stay tubes.

For the strength necessary to resist collapsing pressure on the circular bottom of the combustion chamber of a Scotch boiler the following formula may be used:

$$p = \frac{700\,t^2}{D\,h}.$$

Where t = thickness of plate in sixteenths.
D = diameter of circle to which plates are curved.
h = spacing of angle iron stiffeners.

In order that this formula may apply, the plate must be stiffened with angle iron stiffeners securely riveted to the plate, and with leaf of angle iron at least .8 that of plate and height at least one-half the pitch of stiffeners. With this form and proportion of stiffener the relation between the thickness of plate, the steam pressure and pitch of stiffeners may be worked out by the formula given above.

Thus, for example:

$t = 9\text{-}16$ inch.
$h = 6\ 1\text{-}2$ "
$D = 44$ "

Then $p = \frac{700 \times 81}{44 \times 6.5} = 198$ pounds.

Q. 203.—Will you please inform me as to how I can figure out the capacity in gallons of a centrifugal pump? I have one connected to bilge, and wish to find its capacity in gallons per minute, but no one out here seems to know how to get it, although I have made several inquiries. If you can enlighten me I will appreciate it. C. F. B.

A.—There is no simple formula including the various items involved in the operation of a centrifugal pump and giving the capacity which may be expected. The delivery of such a pump will depend on the diameter and revolutions of runner, on the size of discharge pipe, on the total head from supply level to discharge level, and on the character of the discharge piping as regards turns and bends, and whether there is a single lead or multiple lead as in a surface condenser.

Builders of the usual type of centrifugal pump usually plan on a velocity through the main pump discharge of 500 to 600 feet per minute on the average. If this velocity is realized then the capacity in cubic feet per minute is found by simply multiplying the area of the discharge pipe in square inches by this figure and dividing by 144. Thus, a 10-inch discharge with a velocity of 600 feet, would correspond to a delivery of $600 \times 78.54 \div 144 = 327.24$ cubic feet per minute = 2,446 gallons.

The next point is the velocity of runner necessary to realize this velocity and therefore the corresponding capacity. This is usually reckoned as the linear or running speed of the tips of the vanes, and should be about 500 times the square root of the total head in feet. This total head is the difference in level between supply and discharge, including suction and delivery heads, with added allowance for friction; and it is in estimating the latter item that judgment is required. Thus, in illustration: if the difference in level between supply and discharge is 12 feet and we add 4 feet as the equivalent of the frictional resistance, then the total head will be 16 feet, and the runner speed should be about $500 \times \sqrt{16} = 2{,}000$ feet per minute. With a runner 30 inches in diameter this would mean revolutions of about 250 per minute. The discharge capacity of the pump is of course under control by means of the revolutions, and in the case above cited if the full capacity is not realized with the revolutions given the number must be increased until the proper capacity is reached.

Q. 210.—We have a compound engine with cylinders 4 and 7 inches by 6 inches installed in a launch 36 feet long by 6 1-2 feet beam. The engine runs non-condensing at 350 revolutions per minute and turns a wheel 26 inches diameter and 48 inches pitch, driving the boat at about 12 miles.

This engine we are wishing to change to a triple with a low-pressure cylinder 13 inches diameter, and place it in a boat of good lines 50 feet long by 9 feet beam. We propose to install a new boiler which will supply steam at 220 pounds pressure at the boiler, and to run the engine condensing at about 25 inches vacuum. The high- and intermediate-pressure cylinders will have piston valves, the low will have slide valve, and the cranks will be set at 120 degrees. It is expected that 500 revolutions will be attained. Will you please tell us what power should be indicated in the remodeled engine, and if there is any reason why this outfit should not come up to expectations?

A.—The combination of a 13-inch l. p. cylinder with your 4- and 7-inch cylinders for h. p. and i. p., would hardly make a well-proportioned triple-expansion engine. The area ratio between the l. p. and h. p. would be $(13)^2 \div (4)^2 = 169 \div 16 = 10.6$, which is rather excessive for standard marine practice. A better proportion would be given by a 12-inch l. p. This would give an area ratio between the l. p. and h. p. of $(12)^2 \div (4)^2 = 144 \div 16 = 9$. This is well on the high side of marine practice, but results from fitting a low-pressure cylinder somewhere nearly in suitable ratio to the high and intermediate which are already fixed. With such an engine and a rather late cut-off in the h. p. cylinder, say 3-4, you should get a total expansion ratio of about

12, and with 220 pounds steam and 500 r. p. m. should develop about 60 I. H. P.

It is doubtful if you would get very much more than this with a 13-inch l. p. cylinder. It is true that the cylinder would be larger and the steam would be expanded further, but the mean effective pressure would be less and the gain would be very small. We must remember that primarily the power developed will depend on the main factors—amount of steam entering the engine and the extent to which it is expanded. In the cases we are considering the amount of steam entering would be the same in either case, and the only difference would be that due to the expansion with a 13-inch as compared with a 12-inch l. p. cylinder. This would be too small to be of practical value, and, in fact, would be in some part at least offset by an increased loss due to cylinder condensation.

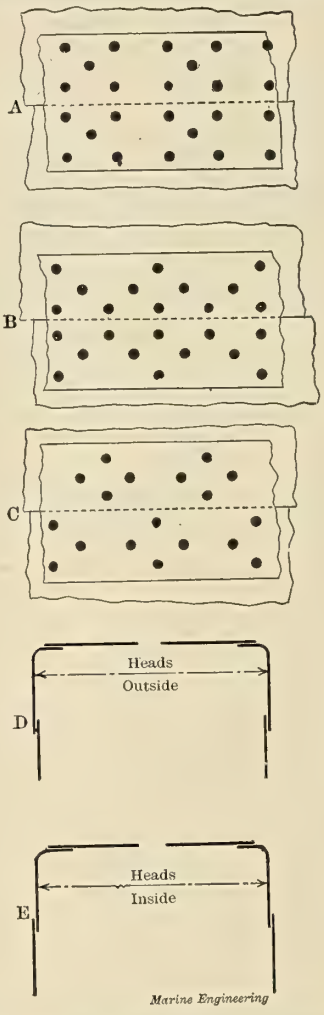
A still nearer approach to standard practice as regards the total number of expansions suitable for small engines such as the one here considered, would be realized with a 10.5- or 11-inch l. p. cylinder, giving with suitable cut-off in the h. p. from 10 to 12 total expansions and about the same power as above. This, however, would not give quite as suitable a proportion for the intermediate as the 12-inch l. p., although the 11-inch l. p. would give a fair proportion and might, on the whole, be the best value, having in view the general combination.

Your propeller for this engine will naturally have to be of a size and general design entirely different from that on your old boat, and adapted to the speed and other conditions which you expect to realize with your new outfit.

Q. 211.—Will you please advise which riveted butt strap is the stronger, *A* or *B*? The same conditions exist in both cases as regards diameter of rivets, thickness of butt strap, size of boiler, etc. Also please decide which is the correct position to place a head in the steam space of a boiler as per sketch *D* or *E*.

A.—If it is to be understood that in joint *A* the rivets are equally spaced in the inner and outer rows on either side the center line, while they are double spaced in the middle row on each side, then such a form of joint can hardly be considered as a representative or desirable form of fastening for riveted work. It is certainly not a common form of joint for boiler fastening. If, however, you had in mind a joint of the type shown in *C*, which is frequently met with in marine-boiler construction, then as between joints *B* and *C* it may be said that, with proper proportions between thickness of plates, diameter of rivets, and spacing or pitch, each joint may be made thoroughly satisfactory and efficient and there is but little to choose between them on the score of efficiency. For the same strength, however, joint *C* will require fewer rivets and hence less drilling and riveting, and hence less expense in construction. On the other hand joint *B* is rather more easily made steam tight and maintained in such condition. It will be noted that joint *B* consists of a regular double-riveted staggered joint with an additional outside row at double spacing. This makes good steam-tight work and is sometimes preferred on this account, notwithstanding the somewhat greater cost.

Regarding the preferable way of placing the heads in a boiler as shown by your sketches *D* and *E*, this is largely a matter of opinion. Method *E* is, on the whole, more commonly employed, presumably because it gives a little more space between the back head and combustion chamber, and because it places the lap of the two head plates in better relation to lodgment of scale, etc., than



with method *D*. Both methods, however, are employed, and presumably with but small difference in general applicability.

Q. 212.—Which do you consider the better crank arrangement for a two-cylinder, four-cycle gasoline marine motor, with cranks 180 degrees apart of both together, giving an impulse at each successive revolution?

What is the best method of balancing the pistons in the latter case? Can you give any rule or formula for doing so?

What is a good method for determining fly-wheel diameter and proportions, or inertia?

A.—With a two-cylinder, four-cycle motor, cranks at 180 degrees, two impulses are received in four strokes, the impulses coming in pairs with a pair of non-impulse strokes between. Thus, if we call the strokes of one of the motors 1, 2, 3, 4, 5, 6, etc., then the shaft will receive an impulse on strokes 1, 2—5, 6—9, 10, etc., while there will be no impulse on the intermediate strokes 3, 4—7, 8—11, 12, etc. With the same motor and cranks together the shaft will receive an impulse on strokes 1, 3, 5, 7, etc., while there will be no impulse on strokes 2, 4, 6, 8, 10, etc. It thus appears that the first arrangement will give a double impulse for one revolution and no impulse for the next, and so on, while the second arrangement will give a single impulse for each revolution. The latter arrangement will therefore give a

somewhat more even distribution of turning effort and will conduce to steadier running with the same size of fly wheel, or will admit the use of a somewhat smaller wheel with an allowable range of speed fluctuation. To set over against these results, which are useful so far as they go, we have the decidedly unbalanced condition of the moving parts which naturally results from this combination. A double engine with cranks together has exactly the same lack of balance which the single engine has, while with cranks opposite, the moving parts are balanced completely as regards the so-called primary inertia forces. There remain, it is true, the secondary inertia forces, but these cannot in any event be balanced without the use of additional sets of moving parts and the introduction of features of arrangement not desirable in gas-engine operation. The two-cylinder engine with cranks opposite is therefore as well balanced as it is practicable to make an engine of this type, and this fact has led to the general use of opposite cranks in such engines.

With regard to the problem of balance for the engine with cranks together, it should be first remembered that it is not alone the pistons which require counterbalance, but the connecting rods and cranks as well. If these are to be counterbalanced it must be by the use of a rotary weight in the shaft located opposite to the crank—the usual form of shaft counterbalance. The amount of this counterbalance may be obtained by the following rule:

(1) Find the weights of all the moving parts except the crank shaft.

(2) Add together the weights of piston and connecting rod and multiply the sum by the crank throw or half stroke.

(3) Find by computation or otherwise the weights of two crank throws and a crank pin and add.

(4) Estimate the distance from the shaft center to the center of gravity of the crank comprising the two throws and the pin, and multiply the total weight in (3) by this distance. This gives the moment of the crank about the shaft center.

(5) Add the results in (2) and (4) and the sum will be the total moment for the shaft counterbalance. This total amount may then be divided in any convenient proportion between weight and arm. Thus a moderate weight with a considerable arm may be fitted, or a greater weight with a smaller arm. It is only necessary that the weight fitted multiplied by the distance of its center of gravity from the shaft center equal the sum of the results found in (2) and (4).

This will give the counterbalance for one engine; the same must, of course, be fitted for each.

For the size of fly wheel the following approximate formula may be employed:

$$W = \frac{200{,}000{,}000\ n\ H.\ P.}{R^3\ D^2\ c},$$

where n is the greatest number of strokes which the engine is expected to run without an impulse, and usually taken as 7 to allow for a miss in the ignition.

$H.\ P.$ is the horse power developed.

R is the revolutions per minute.

D is the diameter of the wheel in feet.

c is the fraction of fluctuation to be allowed in the speed of the engine.

W is weight of fly wheel rim in pounds.

For safety the relation between R and D should be such that the rim velocity will not exceed 100 feet per second.

Thus, for example, suppose $n = 7$, $H.\ P. = 10$, $R = 500$, $D = 2$, $c = .05$. Then we have:

$$W = \frac{200{,}000{,}000 \times 7 \times 10}{125{,}000{,}000 \times 4 \times .05} = 560 \text{ pounds.}$$

Q. 213.—(*a*) I wish to know the proper size for an air compressor to deliver 4 cubic inches of air each stroke at 40 pounds pressure, the compressor to make five hundred strokes per minute.

(*b*) My present pump is 2 inches diameter by 2 inches stroke, and I can only maintain ten pounds pressure. The inlet discharge valves are 1-2 inches diameter. Please tell me what is the matter.

A.—(*a*) This is a very high speed at which to run an air compressor of ordinary type, for it scarcely gives time for the valves to act. To find the size of cylinder, however, to compress air to 4 cubic inches at 40 pounds pressure, we use the following formula:

$$v_0 = \frac{p_1}{p_0} v_1,$$

where p_0 and v_0 are the pressure and volume at the beginning of compression and p_1 and v_1 the pressure and volume at the end of compression.

In compressing air, corrections must be made for the increased pressure due to increased temperature. Therefore, this formula can only be used if the air is cooled by water jacket. It is impossible to actually keep down the temperature of the air during compression to that of the air as it is admitted, but for simplicity's sake we take the formula as it stands. The pressures taken must be absolute pressure. In this case we compress to 40 pounds. Therefore,

p_0 = atmospheric pressure, or, 14.7 pounds.
$p_1 = 40 + 14.7 = 54.7$.
$v_1 = 4$ cubic inches.

Therefore, we have for the cylinder displacement,

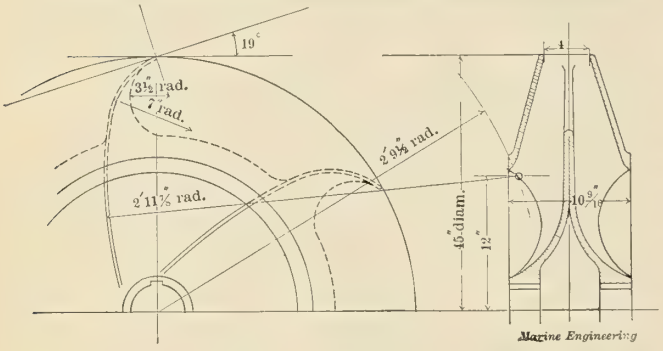
$$v_0 = \frac{54.7}{14.7} \times 4 = 14.7.$$

To allow for leakage, etc., this volume for the air compressor cylinder should be increased say to 18 cubic inches. There are several sizes of cylinders that would comply to this requirment, such as one 2 inches stroke, 3 3-8 inches diameter; or one 4 inches stroke, 2 7-16 inches diameter. In place of having such a small cylinder and high number of strokes, would suggest that you cut the strokes in half and double the cubical contents of your cylinder.

(*b*) By the same process as above you will find that to compress 4 cubic inches of air to 10 pounds pressure requires a cylinder of about 6.7 cubic inches capacity, which is about the size of your cylinder, and therefore there is nothing specially the matter with the pump except that it is too small to do the work.

Q. 214.—It is indeed gratifying to get some exact data on centrifugal pumps, such as given by Mr. P. P. Bird in his article in your March issue. I would like to find out, if possible, what in this pump is the angle of relative discharge from the fan, to a tangent to the periphery of the fan, as this is an important factor in determining peripheral velocity. H. D. B.

A.—The angle asked for is as shown in the cut to be about 19 degrees, where is also given a diagram of the method of laying out the runner for this special pump. You will note in the section at the right hand that the



discharge at the periphery is contracted, which is done in order to make the speed of the water more uniform throughout its passage from hub to circumference.

Q. 215.—Will you please let me know through your Query and Answer column how to figure the efficiency of a boiler for a pipe system and an engine, and the efficiency of the arrangement as a whole? Also, how to figure the thermal efficiency of the above separately and collectively? A CONSTANT READER.

A.—The term "efficiency of a steam plant" may be interpreted to mean almost anything. In the first place, there are the efficiencies of the furnace and heating surface of the boiler, efficiency of the piping, the thermal efficiency of the engine, and mechanical efficiency. The subject is one too large for these columns, and we refer you to any of the standard steam-engineering books on this subject.

Let us assume a small modern plant showing average good results, and consider the *thermal* efficiency.

Under the best conditions on recorded tests, 13 pounds and over of water have been evaporated per hour from and at 212 degrees, per pound of coal containing 14,000 British thermal units. The heat in the coal is, of course, the figure used in basing thermal efficiency in this query. An evaporation of 10 pounds is very good; let us assume that in our plant 9 pounds of water are evaporated per hour per pound of coal.

The heat required to evaporate one pound of water from and at 212 degrees is 966 B. T. U. nearly. Therefore, 9 pounds of water evaporated will represent 8,694 B. T. U.; therefore, the efficiency is $\frac{8,694}{14,000} = 62.1$ per cent.

The radiation in piping would depend whether or not the pipe is covered with non-conducting material, kind and thickness of material, and the length of steam lines. Under good conditions there should not be a loss of over 2 per cent., *i.e.*, the efficiency would be 98 per cent.

A multiple-expansion engine should indicate a horse power on from 12 to 25 pounds of steam per hour. Some very low figures have been recorded, but 18 pounds is very good practice. The heat required to evaporate 18 pounds of water per hour, from and at 212 degrees, into steam $= 18 \times 966 = 17,388$ B. T. U. Now, the mechanical equivalent of heat is the number of foot pounds required to raise one pound of water one degree Fahrenheit, and, by experiment, this is found to be 778 foot pounds.

Therefore, I. H. P. $= \frac{33,000}{778} = 42.4$ B. T. U. per minute $= 2,545$ B. T. U. per hour. Now, for our engine, the thermal efficiency will be $\frac{2,545}{17,388} = 14.6$ per cent.

With these efficiencies, the efficiency of the plant will be $62.2 \times 98 \times 14.6 = 8.9$ per cent.

Q. 217.—Does the time served on board a United States naval vessel by a machinist in the steam-engineering department count for a similar period of time served in the engine room of a sea-going ship in applying for an engineer's license from the United States Steamboat Inspection Service? Also, can a machinist after one year at sea on a ship of our government make application for engineer's license? M. B. R.

A.—We would refer you to page 65 of the General Rules and Regulations prescribed by the Board of Supervising Inspectors of Steamboats, a copy of which may be obtained by applying to the board, Department of Commerce and Labor, Washington, D. C.

We are advised by the supervising inspector of the second district that the service of machinist would meet the requirements of the rules and regulations, provided such service was had in the engineer's department of the steam vessel when she was in commission; and that the applicant may apply after having one year's service in said department, provided he is a regular machinist by trade.

Q. 219.—Will you please inform me whether there are any schools in the United States teaching marine engineering, or any ships in the merchant or naval service that receive cadets for teaching this branch? I am about to graduate from high school and would like to take up a course.

A.—There are several schools of marine engineering and naval architecture at many of the colleges. Prominent among these is the school of marine engineering, Cornell University, Ithaca, N. Y.; Boston Institute of Technology, Boston, Mass. Webb's Academy, Fordham Heights, New York, gives instruction in these courses. The courses in the colleges are generally more advanced and are taken up in the junior and senior years. Two of the correspondence schools also have to offer courses in these subjects. You may obtain full particulars by applying to the registrars of the colleges and schools.

EDITOR, MARINE ENGINEERING:

In the March issue of your instructive paper, in answer to query No. 195, you state that there is no direct gain, in terms of heat, in using a heater provided with steam direct from the boiler. Permit me to state that after an extensive experience of live steam feed water heaters. I have never failed to find that the use of same resulted in the economizing of fuel and the reducing of the boiler repair bills.

I have on one of the vessels under my supervision a live steam feed water heater, which puts the water into the two Scotch boilers at a temperature of 350 degrees Fahrenheit, with steam at 160 pounds above the atmosphere. The chief engineer of this vessel reports a gain of about 8 per cent. in fuel economy. In the opinion of the writer, this is entirely due to the improved conditions brought about inside the boilers by the using of the high-temperature feed, thus causing the circulation of the water in the boilers to be greatly accelerated. Possibly one might not call this a direct gain, but that it is a gain there is no doubt. The raising of the feed water to some 200 degrees Fahrenheit by means of an exhaust heater, while excellent in itself, does not go far enough. D. B. CUMMING.

TECHNICAL PUBLICATIONS.

The Lay-out of Corliss Valve Gears. By Sanford A. Moss. Van Nostrand's Science Series, No. 119. Size 3 1-2 by 6 inches. Pp. 108, with diagrams and 3 folding plates. New York: D. Van Nostrand Company. Price 50 cents.

This discussion of the Corliss valve gear has been prepared by the author in order to fill what has been a clearly evident lack in the technical literature of the day. Widely used as the Corliss valve-gear mechanism is, it does not seem to have been adequately treated from a theoretical and fundamental point of view; from such a point of view as is needful for thoroughly intelligent and resourceful design. A complete discussion is given of the theoretical principles underlying the kinematic design or lay out of a gear with single eccentric, and this is followed by plain directions for making the lay out on the drawing board. The methods herein given should possess a pronounced advantage over the empirical and thumb rules so commonly used hitherto, the latter giving thoroughly reliable results only when in the hands of designers of considerable experience.

A briefer discussion is also given of the gear with double wrist plate and long range of cut off, although the complete kinematic theory of this gear is not developed.

The work is divided into eight chapters, dealing with a description of the ordinary Corliss valve-gear mechanism and its operation, with the influence of angular advance, with the relative motions of eccentric wrist plate and valves, with the theory of the Corliss wrist plate, with valve displacement curves, with the selection of the arbitrary dimensions of a Corliss gear, and with the layout of a single wrist-plate gear as a drawing-board problem.

The treatment throughout is clear and should be readily followed by all who are likely to be concerned in work of this character. The discussion in Chapter VII. of the selection of the arbitrary dimensions of a gear is especially timely, pointing out as it does the large number of variables and the innumerable ways in which these may be selected without apparent material effect on the results to be obtained. These various items are discussed and their influences are pointed out, and practical suggestions are given for their determination in such way as to relieve the problem of ambiguity, and to insure such arrangements and proportions as are warranted by the best practical experience.

The work is cordially recommended to all who may be concerned with the special problems which arise in connection with the design of valve gears of this type.

Bevel-Gear Tables.—A collection of tables and necessary explanation to enable anyone to figure bevel gears without the use of trigonometry. By D. Ag. Engstrom. New York: Locomotive Publishing Company. Price $1.

This is another of the Derry-Collard manuals; clear, practical, and to the point. While it is true that few engineers are now called on to determine the details of bevel-gear design, such items being now more commonly bought from the maker like so many yards of cloth from the merchant, yet occasions may arise when such work must be done, and this little book would then be hailed with satisfaction as the means of saving much tedious computation.

The tables are preceded by a description of the various elements of a bevel gear and of their relations to each other. These are followed by a series of tables covering all possible combinations of gears from 12 to 47 teeth, and readily adapted to any pitch by a mere operation of division. With these tables in hand it is only necessary to know the pitch at the outer diameter, the face, and the number of teeth. All other elements are then directly determined from the tables and without the trigonometric computations which would otherwise be required. This little book should find a welcome place in the library of every designer who is liable to be called on to deal with bevel gears.

SELECTED MARINE PATENTS.

755,728. WAVE MOTOR. DAVID G. WEEMS, BONANZA, COLO. Two claims.

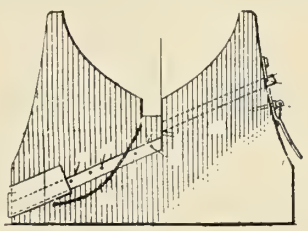
756,030. SUBMARINE BOAT. SIMON LAKE, BRIDGEPORT, CONN. One claim.

756,031. SELF-CLEARING PROPELLER. CHARLES H. LEE, SOUTHAMPTON, N. Y. One claim.

756,244. GLASS-BOTTOM BOAT. LOUIS LARSON, MUSKEGON, MICH. Nine claims.

Claim.—1. A boat having its bottom provided with a glass plate, an inclosure over said plate, and a mirror at the top of the enclosure.

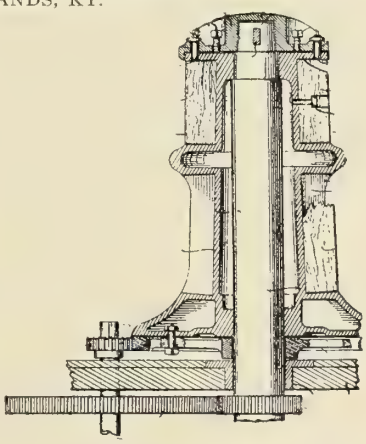
756,661. BOAT CHOCK. IRVING A. LEMM, VICTORIA, CANADA. Filed December 11, 1903. Serial No. 184,805. (No model).



Claim.—1. In a chock or rest for a ship's boat; the construction of the same in two parts having the line of junction from the inboard side of the keel recess in the chock, and extending therefrom to the outboard side of the chock, means for supporting the movable portion against lateral displacement, and means for securing the removable portion to the fixed portion of the chock and for releasing the same from the inboard side of the chock. Two claims.

756,833. WAVE MOTOR. MELVIN D. COMPTON, NEW YORK, N. Y. Seven claims.

756,851. CAPSTAN. GOTTLIEB HARTWEG, DISTRICT OF HIGHLANDS, KY.

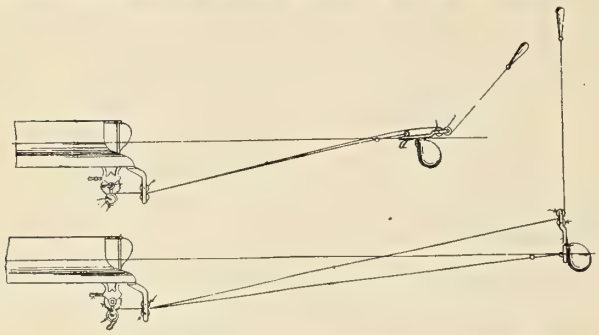


Claim.—1. In a capstan, the combination of an iron barrel, a capstan head, a supporting spindle and wooden whelps carried on the iron barrel arranged with spaces between them and projecting above the face of the barrel. Ten claims.

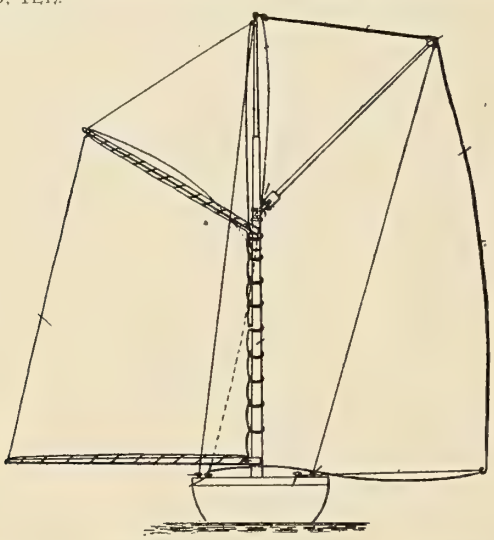
756,887. SOUNDING APPARATUS. JOHN PHILP, NEW YORK, N. Y.

Claim.—1. In sounding apparatus, the combination of a float-anchor secured to a line attached to a reel, said reel, a sounding weight attached to a line passing over a roller or other bearing upon the said anchor float and secured to a reel, said reel, and means for operating said reels for the purpose. Fifteen claims.

757,385. MEANS FOR RETARDING AND STEERING VESSELS. AARON ZERBE, ZERBE, PA. Four claims.

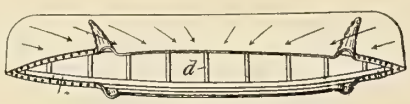


757,474. SPINNAKER SAIL. GEORGE A. LOWRY, CHICAGO, ILL.



Claim.—1. The combination with a mast of a spinnaker sprit or boom connected to the mast near its top or head, and a spinnaker sail having its upper outer corner connected to said boom, and a sheet connected to the upper inner corner of said sail and leading to the mast at a point above said sprit or boom. Nine claims.

757,832. BOAT. JOHN C. NICHOL, MONTREAL, CANADA.



Claim.—1. In the manufacture of a boat first saturating a single sheet of heavy-felted fabric with a resinous substance, then applying said sheet to a mold or pattern which contains a separable keel, then attaching the ends of said blank to the ends of said mold, then smoothing said blank upon the mold from the ends toward midships and attaching the edge of the blank to the mold as the smoothing progresses, then drying said fabric, and finally removing it from the mold. Two claims.

757,858. APPARATUS FOR SCRAPING ORE FROM WINGS OF VESSELS. MATTHEW ANDREWS, CLEVELAND, OHIO.

Claim.—1. The combination, with the hull of a vessel having suitable hatchways, of a frame carrying a winding drum, said frame being adapted to span the hatchway and rest upon the hatch coaming, means for anchoring the frame, and scrapers within the hold of the vessel arranged to be operated by said wind drum. Five claims.

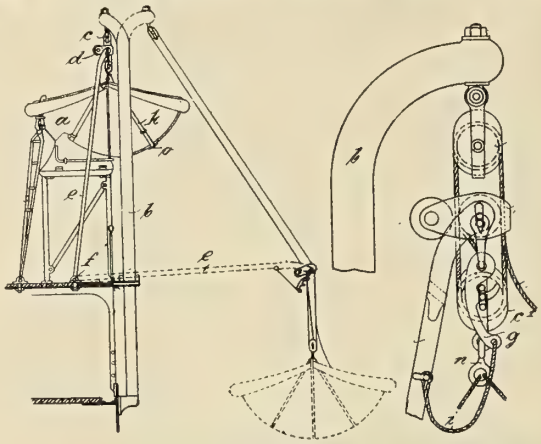
757,926. PILE DRIVER. JOHN H. HOPKINS, PUNXSUTAWNEY, PA. Two claims.

757,960. PILE-DRIVING APPARATUS. HIRAM W. PHILLIPS, QUINCY, MASS. Three claims.

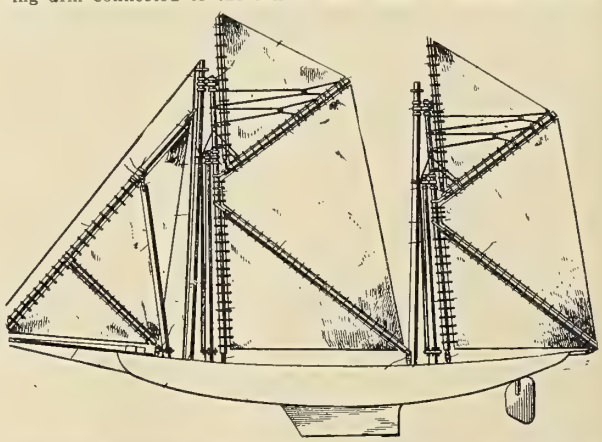
758,043. DEVICE FOR LOWERING LIFE BOATS. JULIUS F. BECKER, ELBING, GERMANY.

Claim.—1. In a device for lowering life boats, the combination of davits *b*, a pulley block *c* suspended by each davit *b*, pulley blocks *c'*, a bolt suspended by the pulley blocks *c'*, ropes *h* passing round the pulleys of each pair of blocks *c* and *c'*, booms *e* turnable around their ends *f* and inclined somewhat outward in the normal position of the boat, a sister block *d* fixed to each boom, said sister block being provided with pulleys for guiding the ropes *h* and hooks *h* and hook *g* for suspending the blocks *c'* to the sister blocks *d*. Five claims.

758,171. RIG FOR SAILING VESSELS. BYRON W. COLLINS, EVANSTON, ILL.



Claim.—1. A fore-and-aft-rigged vessel having a sail-supporting arm connected to the luff or fore leech of the sail and adjustable to arrange the sail in a plane inclined with respect to the horizontal and outboard from the vessel to thereby permit the wind pressure to exercise a lifting tendency on the sail. Twenty-three claims.



Extra Man in Engine Room.

Thomas H. Barrett and James A. Dumont, United States local steam-vessel inspectors at the port of New York, have sent to the superintendents of all ferry companies hereabouts the following letter:

GENTLEMEN: In view of the sudden death of the engineer of the Grand street ferryboat *America*, while on the passage from New York to Brooklyn, with no one at hand to answer the bells of the pilot when the steamer was entering her slip, it is respectfully suggested that you hereafter make provision that there shall always be in the engine room an oiler or fireman capable of acting in such an emergency as this.

A similar casualty in the case of a pilot of a ferry steamer a few years ago caused the Board of Supervising Inspectors to enact a rule as follows: (Section 8, Rule V.).

"All passenger and ferry steamers shall, in addition to the regular pilot or watch, have one of the crew also on watch in or near the pilot house; and this rule applies to all steamers navigating in the night time."

In the absence of a similar rule in the case of engineers of passenger or ferry steamers, this board feels that it is only necessary for it to make the suggestion herein, with the expectation that it will be as cheerfully responded to as though it had the force of statute law.

All the companies announced that they would comply with the suggestion of the inspectors. It is said that Secretary Cortelyou will have a bill introduced at the next session of congress requiring all ferryboats to have an extra engineer always on duty.

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Marine Engineering

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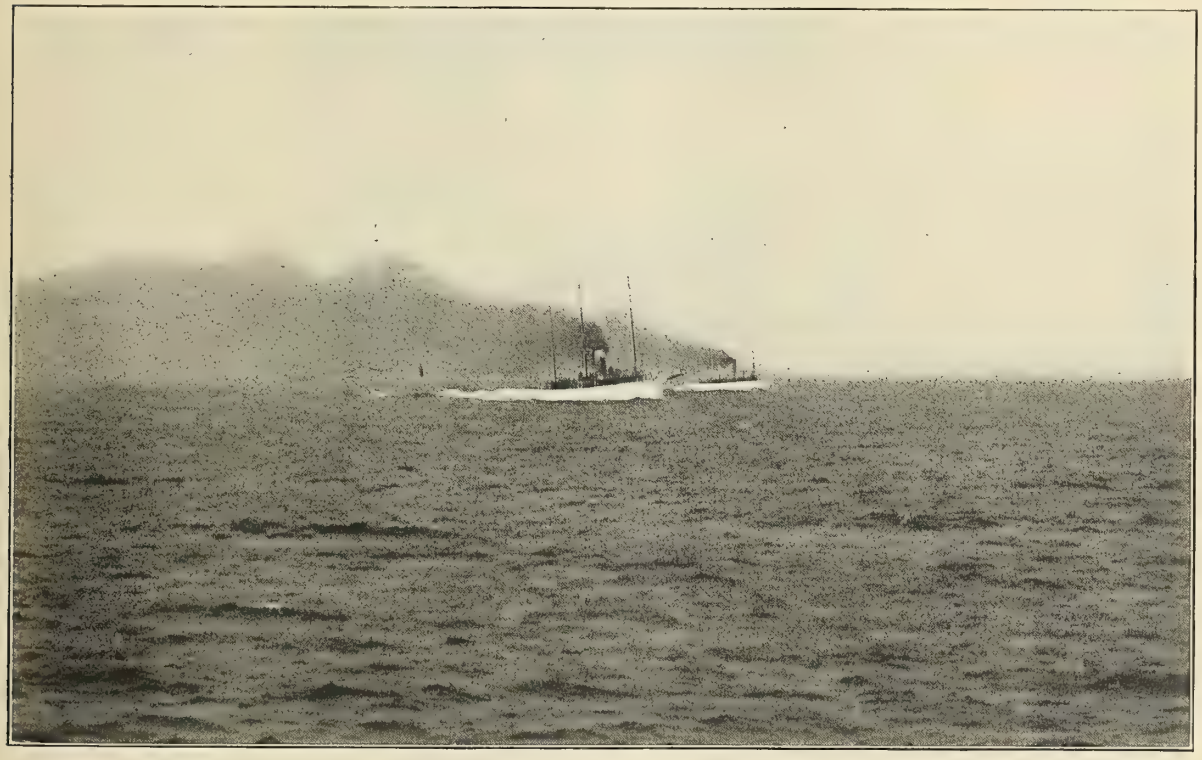
PATENT OFFICE LIBRARY JUL 8 1904

LYSISTRATA CUP RACE.

On June 18, Mr. H. H. Roger's steam yacht *Kanawha* defeated the *Hauoli,* owned by Mr. E. M. Smith, in a 60-mile race at sea, and thereby won the Lysistrata cup. The average speed of the winning yacht over the course was 19.90 knots, while that of the *Hauoli* was 19.53 knots. This trophy is the emblem of superior speed in the steam yacht as the America's cup stands for like perfection in the sailing yacht. There is, however, no handicap for time allowance in the rules governing the Lysistrata cup race. The yachts have to steam under ordinary cruising trim with the usual amount of coal and stores on board, and all boats must be carried except power launches, which may be omitted at the discretion of the owners. The launches were not carried by the competing boats.



THE RACE FOR THE LYSISTRATA CUP, THE KANAWHA LEADING THE HAUOLI SEVEN MILES FROM THE FINISH.

The course lay from Sandy Hook lightship south south-east 30 miles to sea and return,, or 60 nautical miles in all. At 1 hour 15 minutes the preparatory signal was given and when 15 minutes later the starting gun was fired the *Kanawha* crossed the line 4 seconds in the lead. Never during the race did the *Hauoli* take first place, although on the outward leg the race was very close. The two boats made a splendid run. There was a light southerly breeze blowing on the starboard bow, but the sea was smooth as a mill pond. At the outer mark the *Kanawha's* time was one and one-half hours exactly, which means she had covered the leg at exactly a 20-knot pace. Her turning circle was greater than the *Hauloi's* and it is estimated she lost a full half minute to the *Hauoli,* which turned 1 minute 26 seconds later. The wind was now on the port quarter, which made the draft a bit more sluggish, although the forced-draft fans on both boats were running full speed. Ten minutes after turning the *Kanawha* began forging ahead of her rival and from then on increased her lead. Amid the shrieking of the whistles of the observation fleet she crossed the line 3 minutes 29 seconds in the lead. These are the official figures:

	Start.	Turn.	Finish.	El. Tm.
	h. m. s.	h. m. s.	h. m. s.	h. m. s.
Kanawha	1 31 26	3 01 26	4 32 24	3 00 58
Hauoli	1 31 30	3 02 56	4 35 57	3 04 27

It is stated that the *Kanawha* burned 20 tons of picked

(Copyright, 1904, by Marine Engineering, Inc., New York.)

Pocohontas coal and that the *Hauoli* burned 15 tons of hand-picked George's creek coal. Below are the principal dimensions of the two yachts:

	Kanawha.	*Hauoli.*
Length over all	227 ft. 3 ins.	211 ft. 3 ins.
" on water line	192 " 0 "	166 " 0 "
Beam, extreme	24 " 4 "	21 " 6 "
" on water line	23 " 8 "	20 " 10 "
Depth	15 " 0 "	12 " 0 "
Draft	11 " 6 "	9 " 0 "
Least freeboard	6 " 0 "	5 " 6 "
Probable displacement	580 tons	360 tons
Engines:	Twin-screw, triple-expan. 3 cylinders	Sing.-screw, triple-expan. 4 cylinders
Cyl. diams.	14 1-2, 24, 42 ins.	17, 26 1-2, 30, 30 ins.
Stroke	24 ins.	21 ins.
Revolutions	305	290
Boilers:	4 Seabury water tube,	4 Almy water tube
G. S.	179 sq. ft.	133 sq. ft.
Pressure	250	250
Propellers: Diam., approx.	7 ft. 4 ins. 4 blades,	6 ft. 8 ins. 3 blades
Pitch, approximate	9 ft. 0 ins.	9 ft. 6 ins.
Material	Man. bronze,	Man. bronze

The Lysistrata cup is now owned by Mr. Rogers, as he has won it twice in successive years, last year defeating the steam yacht *Noma*.

THE LYSISTRATA CUP, WON BY THE KANAWHA.

[Photograph by New York Herald.]

Test of the Submarine Boat Fulton.

The Holland torpedo boat *Fulton*, which arrived at the torpedo station, Newport, R. I., May 26, has undergone a thorough test. She has had surface, underwater, and endurance trials, and all under the direction of naval officers detailed for that purpose.

On June 6, the *Fulton* was taken to a point off Point Judith, and from there went submerged through a ten-mile course. The periscope was used successfully, the submarine coming to the surface directly between two targets off Block Island, which marked the end of the course. The ten miles were covered in one hour and twenty minutes. There was never a more perfect and searching test of what a submarine can do than this one.

The feature of the tests, and the one which attracted the most attention was that which took place the night of the 6th and the morning of the 7th, when the *Fulton* was submerged for twelve hours without coming to the surface, which was to prove her habitability. During this time the officers and men to the number of nine experienced no discomfort whatever. The meals were cooked on an electric stove, and they ate them as heartily as if they had been served in the open air. Fresh air from compressed air tanks was forced into the compartment occupied by the crew once every four minutes, in conformity with the instructions of the inspection board. At no time did the crew feel any ill effects from lack of air or too much air. Members of the crew say their stay under water was most pleasant and that they slept as comfortably as they would in their own beds. They could plainly hear the noise made by passing steamboats.

An eight-hour continuous sea test ended the *Fulton's* test, in which she is stated to have accomplished all the owners have claimed for her. The official report will be awaited with interest.

GOVERNMENT DREDGES FOR NEW YORK HARBOR.

Two large suction sea dredges intended for deepening the channel in New York harbor are now building by the Maryland Steel Company, Sparrows Point, Md., for the government. The dredges were designed by Capt. E. O. Patterson, who has superintended their construction for the Engineers' Department, United States Army. Three years ago this company built two large suction dredges for the Metropolitan Dredging Company for use in New York and plans of these were given in the June issue, 1901, of MARINE ENGINEERING. The present boats, while somewhat smaller than the former vessels, are of an entirely different design. The machinery for propulsion and dredging is located amidships. There are two large centrifugal pumps, each connected to a suction pipe pivoted to swing overboard vertically, one on the port and the other on the starboard side. These pumps discharge into either or both of the two large bins, one located forward and the other aft of the machinery.

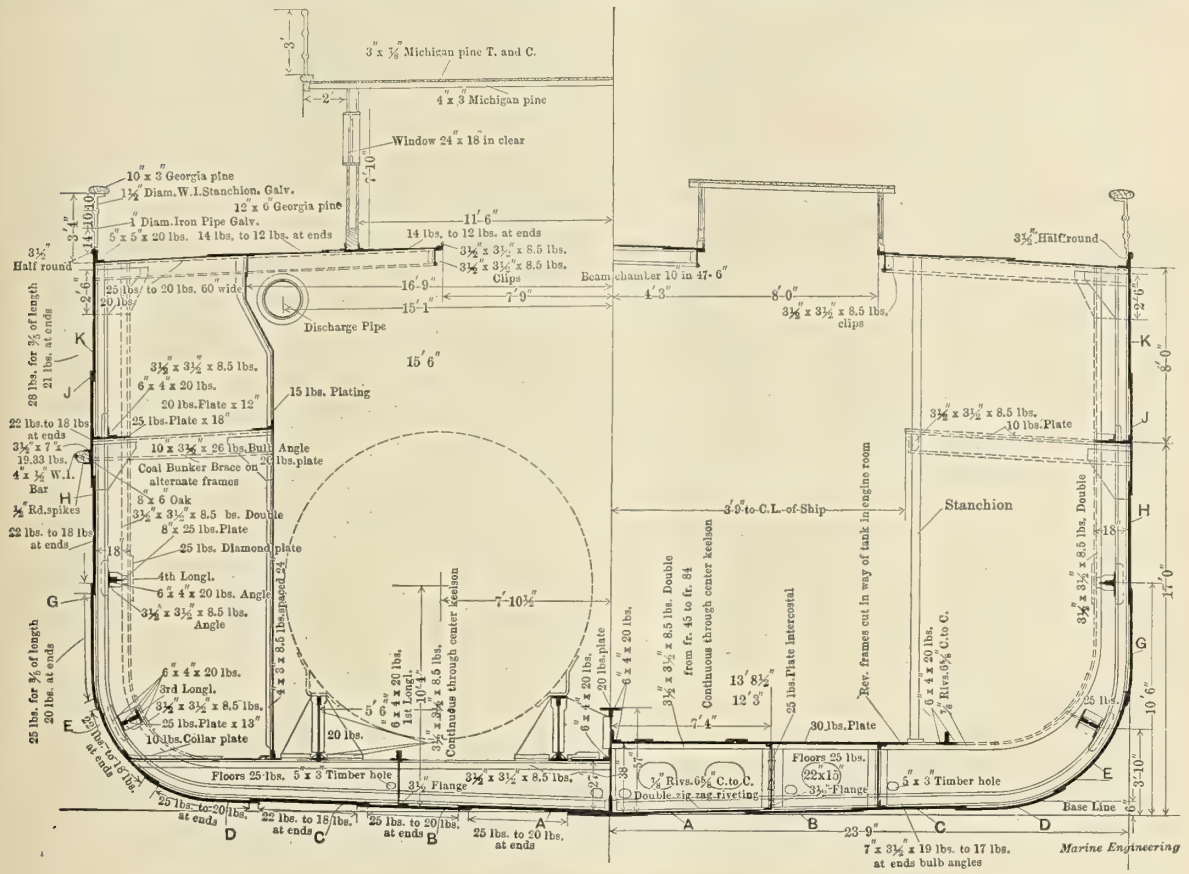
The method of dredging is that the ship proceeds under her own steam slowly over the ground with suction mouth dragging on the bottom. The mud, sand and water are lifted through the pipe by the pumps and discharged into the bins, the water drains overboard. The capacity of the pumps working under a 16-foot head is 95 cubic yards of water per minute. It is estimated that the bins may be filled in one hour, then the suction pipes and drags are raised by means of winches and gearing on the deck and the vessel proceeds to sea and her load is discharged by opening gates in the bottom of the bins. The gates are then closed and the ship proceeds back to her station.

As seen from the plans, the dredges are similar in appearance to ocean steamers, for it is intended that they remain at work during good and bad weather. Much of the channel must be dredged in the open sea. Vessels are expected to remain at their station one week or ten days before returning to port for coal and provisions.

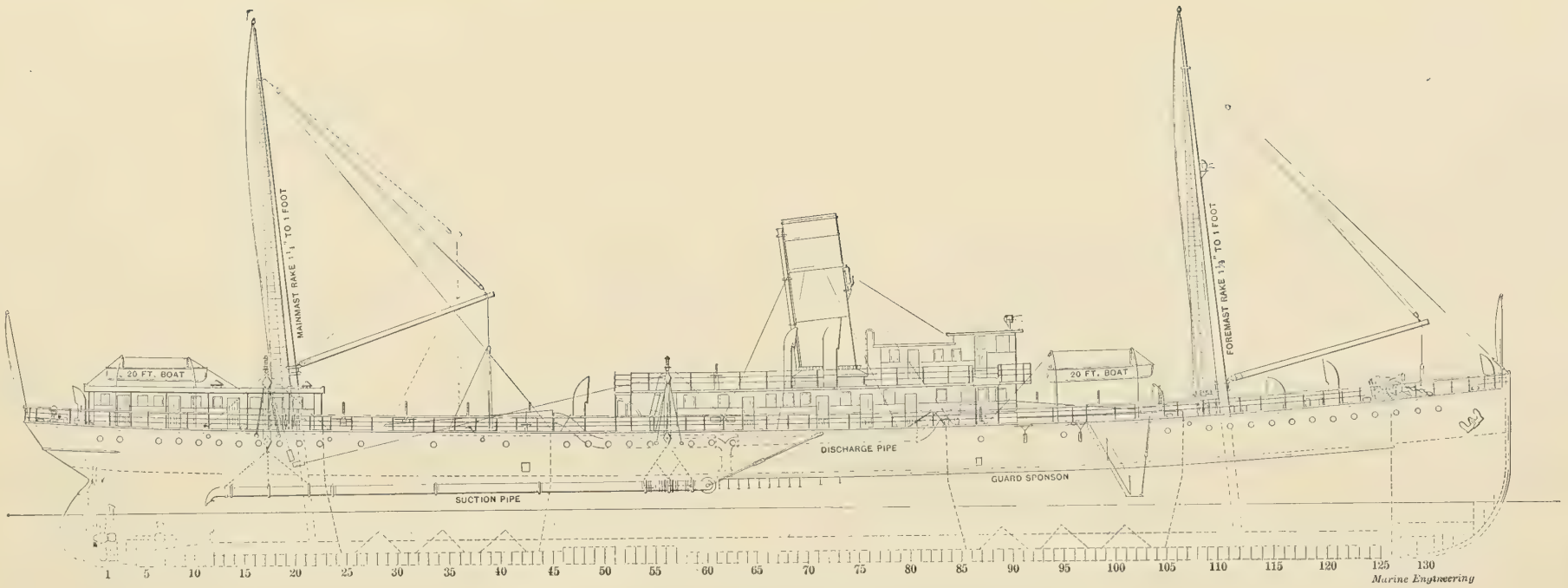
HULL CONSTRUCTION.

The hull is built of mild steel throughout. The stem is forged and the stern post is of cast steel. The rudder is of single plate type, with forged steel stock and arms. The extention stock is a separate forging with palm on lower end bolted to the palm on head of stock. The frames are bulb angles spaced 24-inch centres, with reverse bar on top of floors only. The center keelson is continuous from forward peak to after peak bulkhead and extends above the floors. A bulb angle beam is on every frame at main deck, and at lower deck forward and aft of sand bins, in after-end of engine room and alongside of bins.

The sand and mud is carried in two large bins, one forward and one aft, each being 44 feet long and 39 feet 6 inches wide. The side bulkheads of bins are


3" x ½" Michigan pine T. and C.
4" x 3" Michigan pine
Window 24" x 18" in clear
10" x 3" Georgia pine
1½" Diam. W.I. Stanchion, Galv.
12" x 6" Georgia pine
1" Diam. Iron Pipe Galv.
5" x 5" x 20 lbs. 14 lbs. to 12 lbs. at ends
3½" Half round
14 lbs. to 12 lbs. at ends
3½" x 3½" x 8.5 lbs.
3½" x 3½" x 8.5 lbs. Clips
Beam chamber 10" in 47.6"
3½" Half round
25 lbs. to 20 lbs. 60" wide
20 lbs.
Discharge Pipe
3½" x 3½" x 8.5 lbs.
6" x 4" x 20 lbs.
20 lbs. Plate x 12"
15 lbs. Plating
25 lbs. Plate x 18"
22 lbs. to 18 lbs. at ends
10" x 3½" x 26 lbs. Bulb Angle
20 lbs. plate
Coal Bunker Brace on alternate frames
8" x 6" Oak
3½" x 3½" x 8.5 lbs. Double
8" x 25 lbs. Plate
25 lbs. Diamond plate
4th Longl.
6" x 4" x 20 lbs. Angle
3½" x 3½" x 8.5 lbs. Angle
6" x 4" x 20 lbs.
3rd Longl.
3½" x 3½" x 8.5 lbs.
25 lbs. Plate x 13"
10 lbs. Collar plate
4" x 3" x 8.5 lbs. spaced 24"
5" x 3" x 20 lbs. 1st Longl.
3½" x 3½" x 8.5 lbs. Continuous through center keelson
20 lbs.
Floors 25 lbs. 5" x 3" Timber hole
3½" Flange
3½" x 3½" x 8.5 lbs.
25 lbs. to 20 lbs. at ends
22 lbs. to 18 lbs. at ends
3'9" to C.L. of Ship
Stanchion
Rev. frames cut in way of tank in engine room
3½" x 3½" x 8.5 lbs. Double
6" x 4" x 20 lbs. ⅝" Rivs. 6½" C. to C.
25 lbs. Plate Intercostal
30 lbs. Plate
Floors 25 lbs. (22" x 15")
5" x 3" Timber hole
Base Line
7" x 3½" x 19 lbs. to 17 lbs. at ends bulb angles
Marine Engineering

MIDSHIP SECTION OF GOVERNMENT DREDGES MANHATTAN AND ATLANTIC, FOR USE IN NEW YORK HARBOR.


20 FT. BOAT
MAINMAST RAKE 1:1 "TO 1 FOOT
20 FT. BOAT
FOREMAST RAKE 1½ "TO 1 FOOT
DISCHARGE PIPE
GUARD SPONSON
SUCTION PIPE
1 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130
Marine Engineering

SAIL PLAN OF OCEAN-GOING SUCTION DREDGES MANHATTAN AND ATLANTIC.

thus 4 feet inside of side line of ship. These bulkheads as well as the end bulkheads of bins are stiffened by bulb angles spaced 24-inch centers, well bracketed at lower deck and braced below knuckle line by bulb angle braces. In addition to the vertical stiffeners, the end bulkheads are stiffened by horizontal channels, both above and below knuckle line. Heavy tie rods with turnbuckles in middle connect the horizontal stiffeners on end bulkheads to each other.

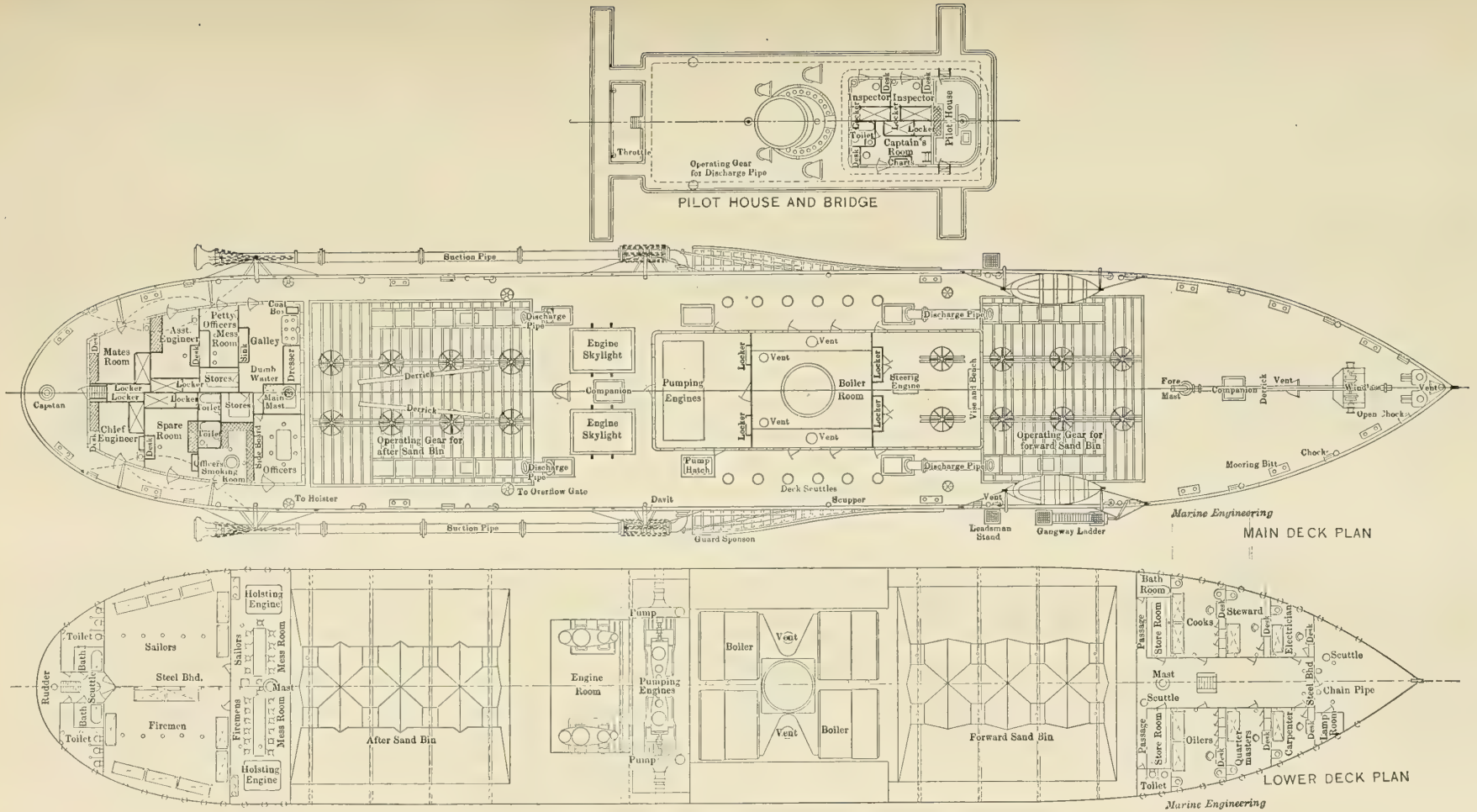
The capacity of these bins is 2,000 cubic yards. Each bin has eight openings, through which mud is discharged, four on each side of center line. These are steel castings riveted to floors, bin plating, and fore and after between floors, and are rectangular in shape. The openings are closed by cast steel gates, hinged on side nearest center line, and are operated by means of a rod, connected to lug in center of gate, which is raised and lowered by a large wheel above bins at the level of the main deck.

There are four watertight bulkheads spaced as follows: A forward collision bulkhead, one alongside of forward bin, between engine and boiler rooms and after peak. The space under the propelling engines is fitted as a double bottom to carry fresh water. Coal bunkers are alongside boilers and fire room and have stowage capacity for 335 tons.

The ship is provided with a 9 by 9-inch steam windlass, two 10 by 12-inch steam winches for hoisting suction pipes and a 7 by 8-inch steam capstan, all of Hyde make; the steam steering engine is of Williamson make with cylinders 6 by 6 inches. Two water tanks of 2,000 gallons capacity each, are located in after hold with all connections to pumps, etc.

The main rail is of Georgia pine 10 by 3 inches, supported by solid forged stanchions riveted to sheer strake. The two intermediate rails are of 1-inch wrought iron pipe. On top of the house and around bridges is a railing composed of three lines of 1-inch wrought iron pipe, supported by solid forged stanchions. A fender of 6 by 8-inch oak is carried from forward end of suction pipe to forward collision bulkhead. The after end is made in sponson shape to protect the pipe.

The crew have large, roomy quarters in after 'tween decks, together with mess-rooms, pantry and toilet rooms. The winches for operating suction pipe are



DECK PLANS OF OCEAN-GOING SUCTION DREDGE, BUILT BY THE MARYLAND STEEL COMPANY.

also on the lower deck aft. The petty officers have quarters forward in the 'tween decks, and are provided with toilet rooms and large sleeping quarters. The officers have rooms in a large house on the main deck aft. In this house are also a large smoking room, officer's mess-room, pantry and galley. The roof is extended to the side of ship, making a good shade deck.

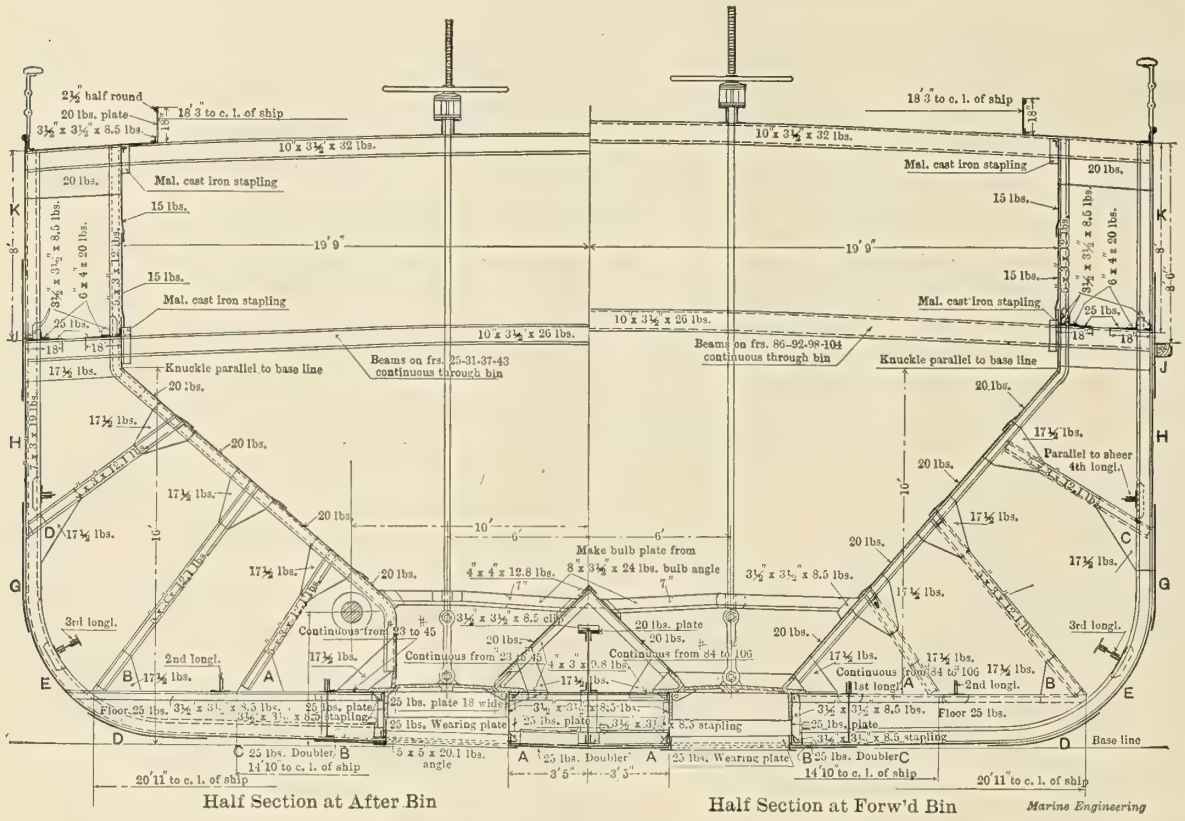
In the house around stack are a large machine shop, steering engine room and space above pumping engines. The pilot house and captain's room are on top of this house.

All houses are sheathed outside with Michigan pine, and inside with cherry, and are fitted with window sashes of hard wood, with thick glass. All state rooms and mess-rooms are provided with inside blinds of cherry. Floors are all of selected oak.

All crew's quarters are finished in tongue and grooved

cypress, and fitted with pipe berths of latest pattern. The ship is schooner rigged, having two pole masts of Oregon pine, the foremast being provided with one boom and the main mast with two.

the two pumping engines are of similar design with cylinders 16 and 32 inches diameter with a stroke of 18 inches. The condensers are independent, with 4011 square feet of cooling surface and an independent con-



SECTIONS AT AFTER AND FORWARD BINS IN THE SUCTION DREDGE FOR NEW YORK HARBOR.

MARINE ENGINEERING DATA CARD. **JULY, 1904.**

NAME—Manhattan and Atlantic. NATIONALITY—American. TYPE—Ocean suction dredges.
LAUNCHED—1904. BUILDERS—Maryland Steel Co. OWNERS—U. S. Army.

Length overall	288 ft. 0 ins.
" between perps	274 " 0 "
Beam, molded	47 " 6 "
Depth, "	25 " 0 "
Load draft	18 " 0 "
Displacement, load draft	5,266 tons
Dead-weight carrying capacity	3,050 "
Block coef	.786
Midship section area	826.5 sq. ft.
Wetted surf	19,677 " "
Speed, loaded, estimated	10 knots
Propelling Engines: Number	two
Type	compound
Valves	piston on H. P.
Cylinder diameters	22 and 44 ins.
Stroke	30 "
Condensed surface	4,011 sq ft.
R. P. M., designed	100
I. H. P., "	1,800
Propellers: Number	two
Material	cast iron, 4 blades
Diameter	9 ft 6 ins.
Pitch	12 ft. 0 ins.
Area, developed	48.54 sq. ft.
Dredging Machinery:	
Centrifugal pumps	two
Pipes, suction and discharge, diam	20 ins.
Engines	2 sets, compound direct connected
Cylinder diameters	16 and 32 ins.
Stroke	18 "
R. P. M.	220
Capacity each, 16 ft. head	95 cu. yds. water per min.
Bins, two, capacity each	1,000 cu. yds.
Condensed surface	1,502 sq. ft.
Boilers: Number	four
Type	single-end Scotch
Pressure	125 lbs.
Diameter	14 ft. 0 ins.
Length	12 " 0 "
Draft	natural
Furnaces, each	three
Least diameter	42 ins.
G. S., total	294 sq. ft.
H. S., "	10,704 " "

MACHINERY.

The propelling machinery consists of two direct-acting inverted cylinder compound engines, having cylinders 22 and 44 inches diameter, with a stroke of 30 inches, and denser for pumping engines has 1501 square feet of surface. The high pressure cylinders are provided with piston valves and the low pressure cylinders with slide valves. The pumping engines are on a raised plat-

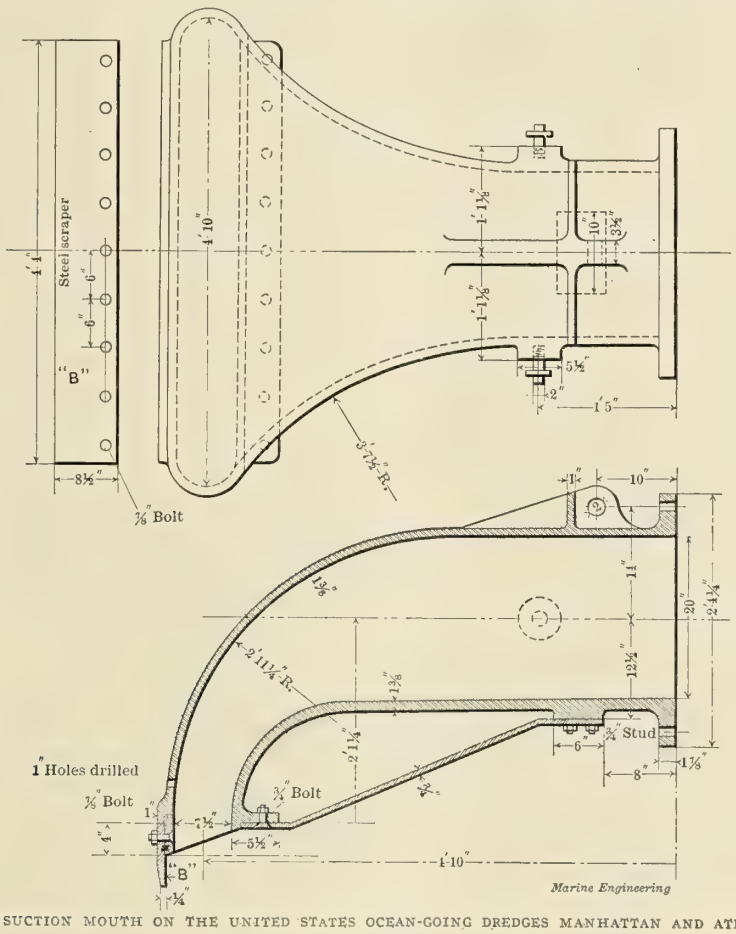
form, underneath which are the pumps for all purposes. One centrifugal pump, 12-inch runner, and driven by an 8-inch engine supplies circulating water for two condensers. A twin air pump with cylinders 16 and 30 inches of 18-inch stroke is fitted to each condenser. The two main feed pumps are 9 and 6 by 10 inches duplex. The bilge is of same type and dimensions; the fire pump is of duplex 14 and 8 inches by 12 inches; the feed, 7 1-2 and 4 1-2 by 8 inches duplex. The auxiliary air pump is a 9 and 14 1-2 by 8-inch simplex and the auxiliary circulating pump is 8 inches diameter driven by a 6 by 6-inch engine. All pumps are of Blake type.

The propellers are of cast iron 9 feet 6 inches diameter and 12 feet pitch, four bladed with a developed area of each 48.54 square feet.

Steam is supplied by four Scotch boilers, 14 feet diameter by 12 feet long, built for 125 pounds steam pressure, working under natural draft. Each boiler has three 42-inch furnaces of Morison type. The total grate surface is 294 square feet, and the total heating surface is 10,704 square feet. There is one double stack extending 32 feet above top of house, the outer stack being 10 feet 6 inches diameter.

The two dredging pumps are of centrifugal type, having suction and discharge 20 inches diameter. These are direct connected to pumping engines and draw the dredged material through the suctions 20 inches diameter, one on each side of ship. The drags, or mouths of the suction pipes, are of cast steel with mouths widened out. The upper end of suction pipes is provided with a piece of hose 10 feet long, connected to steel casting. At each end of the suction pipe, which is 98 feet long, are chain slings connected to falls on 8-inch davits. The hauling part of these falls is led to winches on lower deck aft.

The mud is distributed to bins through the discharge pipes, which are carried under main deck to a point near bins, where they come through the deck and discharge into sluices, with gates at intervals. A large Y pipe is bolted to top of pump with valve, which distributes the flow of material to either bin.



DRAG OR SUCTION MOUTH ON THE UNITED STATES OCEAN-GOING DREDGES MANHATTAN AND ATLANTIC.

An electric lighting plant is installed on lower deck in engine room, for 140 16-c. p. incandescent lamps, and three 50-c. p. for side and masthead lights. A search light of 25 amperes capacity is located on pilot house. The two-wire system is used for all lights. Crew of 60 men, all told.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 103 vessels of 24,691 gross tons built in the United States and officially numbered during the month of April, 1904. The largest steel steam vessels included in these figures are: *City of Columbus*, 5,433 gross tons, and the *Missouri*, 2,434 gross tons.

MOTOR BOAT RACES ON THE HUDSON.

The anticipated interest in fast motor boats has been fully realized and two races for launches and auto boats have already been held this season, under the general direction of the American Power Boat Association. Several new auto boats have appeared this season and, although of practically a new type, have already made a creditable showing in point of speed.

The first event was held under the auspices of the Manhasset Bay Yacht Club of Port Washington, Long Island, and the second event was started from the Columbia Yacht Club house, foot of Eight-sixth street, on the Hudson, New York City. In this latter race were many entries in all classes, and the races proved quite a test of endurance. Of the automobile type there appeared the *Hard Boiled Egg*, owned by William K. Vanderbilt, Jr., which is 35 feet on the water line, 40 feet over all and fitted with a 60-horse-power Mors engine. The *F.I.A.T.*, No. 1, also appeared. She is 30 feet on the water line, 35 feet over all, and fitted with a 35.17-horse-power engine of the same name. She went through the race without an accident and led the others of her class. The boat is owned by Mr. T. N. Tangerman. The *Shooting Star*, owned by Mr. H. A. Lozier, Jr., is fitted with a Lozier engine of 27.14 horse power.

Mr. George W. C. Drexel's *Alert*, a new boat with a 6-cylinder Speedway engine, was entered, although she had just come from the builders without much tuning up. She became disabled on the first run and withdrew, though repairs were easily made afterward, and in an exhibition spin she showed much speed. Mr. Frank Seaman's *Water Lily*, 47 feet 5 inches over all and equipped with a Speedway engine of 40 horse power, also had temporary trouble with the machinery and was the last of her class to finish. The *Japansky*, owned by Mr. J. H. Waldorf, having a Speedway engine of 40.99 horse power, and the *Standard*, the property of Mr. C. C. Riotti, fitted with a Standard engine of 110 horse power, completed the list of prominent auto boats. The *Standard's* performance was excellent and she was the winner of her class. The classification and rating of the boats are given in the table following.

Two courses were laid out, the longer from off the club house to a mark opposite 155th street, then down the river to a stake off 66th street and return, the distance being eight nautical miles. Classes B, C, D, H, I, and J covered it twice, sixteen miles. All the auto boats were to cover it four times, thirty-two miles, but the *Shooting Star*, the *Hard Boiled Egg* and the *F.I.A.T.* went four times over the shorter course, the up-river turning mark being off 129th street, making twenty-four miles. Class K covered twelve miles, while the *Standard*, the *Japansky*, *Alert* and *Water Lily* took the longer course, thirty-two miles. Of these the *Standard* only finished without mishap. The full summary follows:—

Classes B, C, D.—Course 16 nautical miles. Start, 2h. 35m.

Boat and Owner.	Finish.	Elapsed Time.	Corrected Time.
	h. m. s.	h. m. s.	h. m. s.
Queen Bess, R. N. Stevens.	4 34 35	1 59 35	1 42 10
Regina, D. L. Clayton.....	4 37 30	2 02 30	1 47 02
Senta, F. G. Mead.....	4 46 07	2 11 07	1 51 41
Aletes II., R. C. Fisher....	4 31 39	1 56 39	1 56 39
Getty, Morris Vail.....	5 15 48	2 40 48	2 54 11

The *Queen Bess* is the winner, with the *Regina* second and the *Senta* third.

The *Queen Bess* and the *Aletes* II. are equipped with Standard engines, the *Regina* with the Speedway, the *Getty* with the Kepp and the *Senta* with the Howard.

Classes H, I and J.—Course 16 nautical miles. Start, 2h. 40m.

San Toy, W. H. Barrow....	4 14 04	1 34 04	1 33 01
Ardis, R. M. Haddock.....	4 14 34	1 34 34	1 34 34
Kaa, J. J. Amory.....	Did not finish.		

The *San Toy* is the winner.

Classes K and L.—Course 12 nautical miles. Start, 2h. 45m.

Nada, C. A. Godshalk.....	4 09 27	1 24 27	1 24 17
Kotic, C. A. Paine.....	Did not finish.		

The *Nada* is fitted with a Giant engine.

Classes P, Q and R.—Automobile boats; 32 nautical miles. Start, 2h. 50m.

Standard, C. C. Riotto.....	4 31 27	1 41 27	1 41 27
Japansky, J. H. Waldorf...	5 11 33	2 21 33	2 19 00
Alert, G. W. C. Drexel....	Did not finish.		

The *Standard* is the winner. Her racing length is 86.05 and the *Japansky*, 70.35.

Classes S, T, V.—Automobile boats, 24 nautical miles. Start, 2h, 55m.

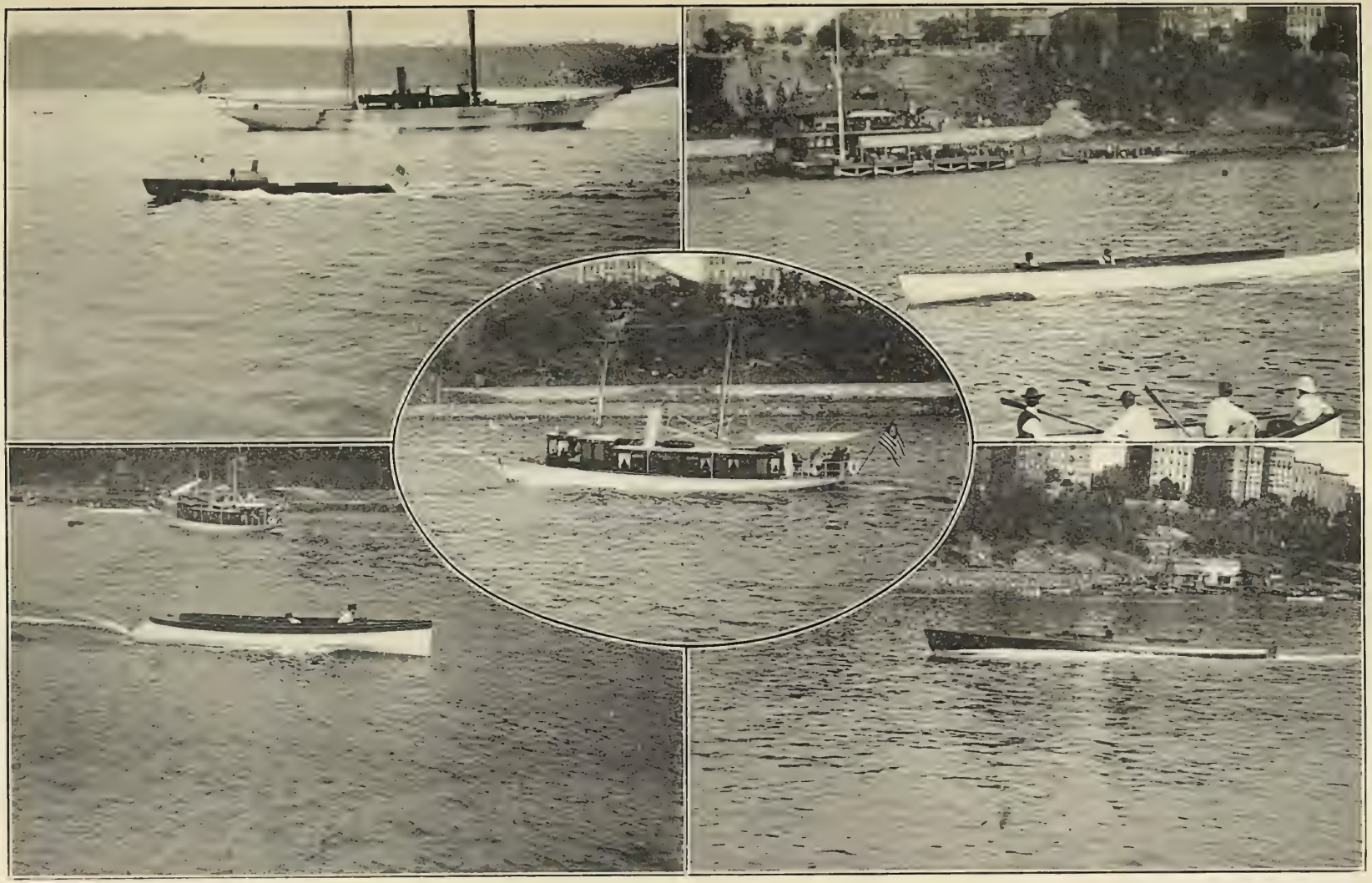
F.I.A.T., C. H. Tangerman..	4 26 07	1 31 07	1 23 24
Shooting Star, H. A. Lozier, Jr.....	4 27 01	1 32 03	1 30 55
Hard Boiled Egg, W. K. Vanderbilt, Jr.....	4 32 21	1 37 21	1 37 21
Water Lily, Frank Seaman.	Did not start in her class.		

The *F.I.A.T.* is the winner, the *Shooting Star* second, and *Hard Boiled Egg* third.

The *F.I.A.T.* has an engine of that name; the *Shooting Star*, the Lozier, and the *Hard Boiled Egg* with the Mors.

The *Standard* covered the course of 32 nautical miles in 1h. 41m. 27s. and the *F.I.A.T.* the 24 mile course in 1h. 31m. 7s.

Pacific Mail Steamship Manchuria.—The steamship *Manchuria*, the latest addition to the Pacific Mail Steamship Company's fleet, to engage in the San Francisco-Orient trade, sailed from New York on June 9, bound for San Francisco. The *Manchuria* is a sister ship to the *Mongolia* and has been completed at the yards of the New York Shipbuilding Company, Camden, N. J. Following are the principal dimensions: Length over all, 615 feet 8 inches; breadth, 65 feet; depth to shelter deck, 51 feet 3 inches; load draft, 33 feet 6 inches; displacement, 27,000. A full description of this vessel was given in MARINE ENGINEERING in April, 1904.



WINNING GASOLINE AUTO BOATS AND LAUNCHES, ENTERED IN THE RECENT HUDSON RIVER RACES.

F. I. A. T. No. 1, winner in 24-mile race.

The Queen Bess, first in 16-mile race, Class B. C. D.

Shooting Star, second in 24-mile race.

The Standard, which won the 30-mile event.

Memories of 1865.

BY FREDERICK C. RUSSELL.

Nearly forty years have passed since the United States monitor *Nantucket* closed her active service in the South Atlantic squadron, off Charleston, S. C. I was at that time acting second assistant engineer, and, believing that a few items from those days may be of interest to the modern engineer, I select from our log book the run from Port Royal to Philadelphia.

On Monday, June 12, 1865, we find all hands getting the ship ready for sea, men coaling ship, and getting in supplies; a gasket is driven under the turret, and the turret lowered as far as possible. At 4 P.M. started fires under the starboard boiler, and by request of our chief a few of the deck hands were detailed for the fire room, to pass coal on the passage north.

Tuesday, June 13, opened fine, with wind southwest and a slight swell. Between 10 and 11 A.M. we left Port Royal in tow of the U. S. S. *Fahkee*. The monitor would follow nicely in tow as long as our engines were running, but if for any reason our propeller was stopped the ship became like a log, almost unmanageable. When running alone, at full speed, she would respond easily to her helm, and turn in almost her own length.

We were but a short distance out from Port Royal when our condenser became heated and we were unable to form a vacuum, so we ran the engines high pressure to Charleston bar, about fifty miles, and anchored outside the lightship at 10:40 P.M. We anchored as far outside as possible, showing no lights. We were bound home and did not care to be noticed by the flagship, as that would mean an order to run inside for repairs, and we felt competent to make our own repairs. The writer had the watch from 8 P.M., and on the ship's coming to anchor commenced to overhaul air pump and condenser, putting in new rubber valves and making new joints. The temperature in the engine room ranged from 135 to 140 degrees.

When the relief engineer came on, at midnight, we arranged to both work the rest of the night, so that we could be off in the morning before the admiral should call us into the fleet. So by 4 A.M., June 14, we had both heads on the air pump and a turn of packing around port trunk of main engines. Of course the force of firemen and oilers in each watch helped in lifting and passing materials. At 6:20 A.M. we started ahead in tow of the *Fahkee* again. At 7:50 A.M. the main bearing became heated. Running water failed to cool it, obliging us to stop and slack up on it a little. At 3 P.M the air-chamber joint of the main feed pump blew out; stopped engines again and made a new joint. Following this the starboard donkey pump began to work badly, and a leak manifested itself at the stern bearing; a little setting up on the gland stopped that, however. The sea was comparatively smooth thus far, which was much in our favor. On this day, at 11 A.M., we made Cape Romain light bearing N.N.W., distant 10 miles; at meridian the light was bearing N.W.; temperature in the engine room 132 to 134 degrees.

On June 15 the sea was smooth in the forenoon; in the afternoon the wind came around northeast and a long swell was rolling in from the gulf stream. There were appearances of squally weather. The ship was pitching some and the engines thumping badly. At 1:20 P.M. the port cut-off eccentric straps worked loose; stopped engines for about half an hour to set up on them and get them working smoothly again. Temperature of engine room 130 to 134 degrees.

On June 16 there was a heavy sea running from the northeast and in the middle of the day stopped engines to key up on crank bearing and connecting rods and in a short time we had everything again working well. About noon we were off Cape Hatteras and altered our course more to northward. Temperature of engine room 121 to 135 degrees.

June 17 opened fine with a smooth sea. At 10 A.M. a leak started in port boiler in No. 5 tube box. Temperature of engine room to-day 124 to 130 degrees.

June 18 was Sunday, and fine weather continued. Very early this morning, between 12 and 1, made Fenwick island light bearing west, distant 12 miles. At 3 A.M. made Cape Henlopen light bearing northwest, distant 15 miles. At 4:30 A.M. saw the land bearing west. At 5 A.M. the charges were fired from the 15-inch and the 11-inch guns; they were to go up the Delaware "free of charge." In some way the turret was not turned far enough to clear our boats and the charge from the 15-inch gun stove the port side of our second cutter. At 10:30 A.M. passed Brandywine shoals. Between 5 and 6 P.M. passed Fort Delaware, and at about 9 P.M. came to anchor below Chester, Pa., on the Delaware. It seemed to us that we had been getting home on the installment plan, a little at a time, and this day could not close without one more event, viz.: our windlass got out of order; it was under cover, and hung from the deck beams, and we had considerable trouble to "let go the anchor." On this job our blacksmith was called into service.

On Monday, June 19, we got under way in the morning, steamed to Fort Miflin and discharged shot and shell all day. At 8 P.M. the leak in our port boiler had increased so that we could not keep the water at the proper level, and accordingly hauled fires from the boiler and blew out the water.

The next day, early in the morning, we steamed up the river with one boiler, and came to anchor off the Philadelphia navy yard, near the *Passaic* and *Lehigh*.

On Wednesday, June 21, 1865, the ship was put in order to go out of commission.

International Engineering Congress.—On October 3 to 8, 1904, an international engineering congress will be held at St. Louis, under the auspices of the American Society of Civil Engineers. Among the papers to be presented are those on the following subjects: harbors, natural waterways, artificial waterways, lighthouses and other aids to navigation, traffic on improved waterways, substitution of electricity for steam as motive power, manufacture of steel, tests of materials of construction, pumping machinery, dredges, their construction and performance, steam turbines, dry-docks, wharves and piers. Under the heading of naval architecture, papers will be presented by Rear-Admiral W. L. Capps, chief constructor, U. S. N., and Sir William H. White, late director of naval construction, England. Professor W. F. Durand, of Cornell university, and Mr. M. Maynard, chief engineer of the French line, will present papers under the general heading of marine engineering.

Foreign Types of Steam and Electric Harbor Cranes.

BY FRANK C. PERKINS.

The steam, hydraulic, and pneumatic crane is of the greatest importance at every large harbor, and the electrically-operated crane for dock work is fast becoming an indispensable mechanism for this class of work. The accompanying illustration, Fig. 1, shows a 4-ton electric crane for the Table Bay harbor, constructed in England by Stothert and Pitt, Limited. It is a movable crane operating upon a double track, of the portal type, with both rails on the same level. Two stationary types of harbor cranes are to be seen in Figs. 2 and 3, constructed at the works of the Duisburger Maschinenbau-Actien-Gesellschaft, formerly Bechem and Keetman, at Duisburg, Germany. The former is a hammer crane of 150 tons normal load and tested to 200 tons. It is located at Krupp's Germaniawerft at Kiel, and the load is moved to various points by the traveling crab of the hammer crane, instead of by raising and lowering the jib in the other type of crane illustrated. The Krupp crane, it is claimed, has the advantage that less power is required for the driving of the crab and greater speed can be obtained. The masses moved are smaller and the efficiency of transport is higher. The revolving crane post is constructed of lattice girders and is surrounded by the supporting frame which transfers the balancing momentum of the crane to the foundations.

At an equal distance of the crane post from the head of the quay the three lateral supporting frames take up the least room and admit passing underneath of one or two lines of rails. The crane post rests on a roller path with 28 conical rollers which run on wrought-steel rails let into cast-steel ring plates.

In the crab are mounted, besides the traveling gear, two sets of lifting gear, each having a pair of drums, of which the larger one carries a maximum load of 150 tons, while the auxiliary lifting gear possesses a capacity of 45 tons. The driving is accomplished by a set of three motors, which drive an equal number of pairs of worm wheels revolving in opposite directions, the wheels of which drive the cogwheels at the end. The motors are connected by means of clutch couplings with the large or small lifting gear, as may be required.

On a level with the driver's platform, the revolving gear is mounted on the bottom girder of the jib and acts upon a rod rail which surrounds the upper ring bearer. The speed and friction momenta offering resistance to the revolving are thus principally taken up by the supporting frame resting on a wide basis and transferred to the foundations. A light scaffolding is also provided on the jib of the crane, which carries a

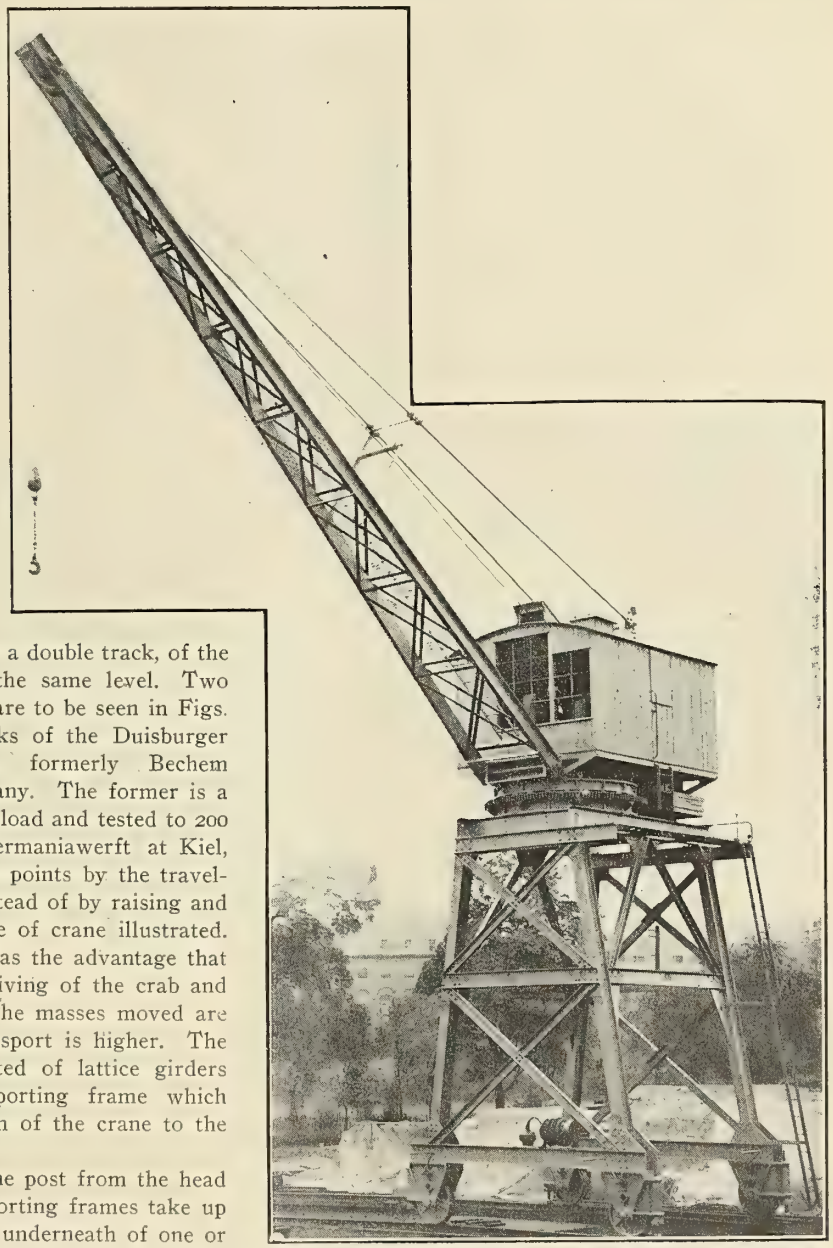


FIG. 1.—4-TON ELECTRIC CRANE, FOR TABLE BAY HARBOR.

traveling crab and electric winch which is meant for speedily lifting loads up to one ton. The crane is operated by a direct current of 550 volts pressure, the crane revolving through a radius of 35 meters at a rate of 30 meters per minute, while the crab travels at the rate of 5 meters per minute. The auxiliary lifting gear raises a load of 45 tons, the greatest projection being 116 feet, at a rate of 20 feet per minute, and with a load of 150 tons on the large lifting gear, the greatest projection being 75 feet, the speed is 5 feet per minute. The track of the traveling gear is nearly 120 feet above the quay.

The derrick crane shown in Fig. 3 has a carrying capacity of 150 tons and is noted in the act of setting

FIR. 2.—150-TON HAMMER CRANE AT THE KRUPP WORKS, KIEL.

one of the large masts of the ship *Kaiser Karl der Grosse,* at Hamburg. This crane was erected at the wharf of Messrs. Blohm and Voss for serving ships lying alongside the quay or in the floating dock. It is operated by steam power. It is claimed by some prominent engineers to have several distinct advantages over the lately-introduced so-called hammer cranes with horizontal jib, and is said to be especially suitable for wharves where a full revolution of the crane of 360 degrees is not required or, in consequence of local conditions, impossible.

In the three-legged frame of this design very little room is taken up and the crane does not disturb or impede the traffic on the dock in the least. Even locomotive cranes with large jibs for auxiliary service may pass under the principal leg without difficulty. The principal advantage claimed for this crane, which in consequence of the non-existence of a counterweight is altogether much lighter, lies in the fact that it is provided with an adjustable jib, whereby the height of the ship to be served is of no consequence, as the masts can easily be avoided and any part of the ship between masts may be reached. The great height of the pulleys of 152 feet with the jib drawn in renders it possible to reach the highest parts of the ships, even if they lie in the dock. With a load of 150 tons, the greatest projection of jib being 66 feet, the rate of lifting is 4 feet 3 inches per minute, and with a load of 75 tons and the same projection of jib the speed is 8 feet 6 inches per minute. With the small hook and a load of 30 tons, the greatest projection being 10 feet 6 inches, the speed of 20 feet per minute is attained, while with a reduction of load to 10 tons the rates may be increased to 40 feet per minute.

This crane is operated by means of two double-cylinder steam engines, one of which drives the gear for lifting, while the other one transmits the power for slewing and altering the radius of the jib. The energy created by the slewing is mostly consumed by a friction clutch built into the shaft of the revolving gear, which excludes any compression on the frame or the driving gear.

Among the advantages of electric cranes may be mentioned the fact that the power supply is simply by means of a few thin wires, and the low weight of the electric motors and smallness of space occupied by them make them especially desirable. The last-mentioned qualities render it possible to employ three distinct motors corresponding to the three main movements of the crane, so that all the old complicated gearing, with its

frequent vexations, is entirely dispensed with. Raising and lowering is performed by one motor, a second one directs the swinging right and left, whilst a third motor has the function of moving the entire crane into a new position. It hence appears that the ideal electric crane is a three-motor crane.

This crane has the least complicated and the least power-consuming gearing, as is clear from the fact that each chief movement has its own motor. The latter is in each case in exact proportion to the work required of it, *i.e.*, a powerful one for raising, and again smaller motors for the other two movements. Each motor is only connected when working. No useless consumption of current is necessary. Hence the working is of the most economical nature possible, the more so as the size of each motor is in proportion to the work required of it. The greatest possible economy in the use of current may be reckoned as the first great advantage of the electric crane. Each of the movements, as we have seen, being independent of the others, two or three movements can be effected simultaneously, or even one by one. The possibility, however, to perform three distinct movements simultaneously renders it possible to carry the load on the shortest path from one spot to the other. Thus a further advantage of the three-motor crane is the quickest possible working, and, as time is money, the advantage gained will be of high value.

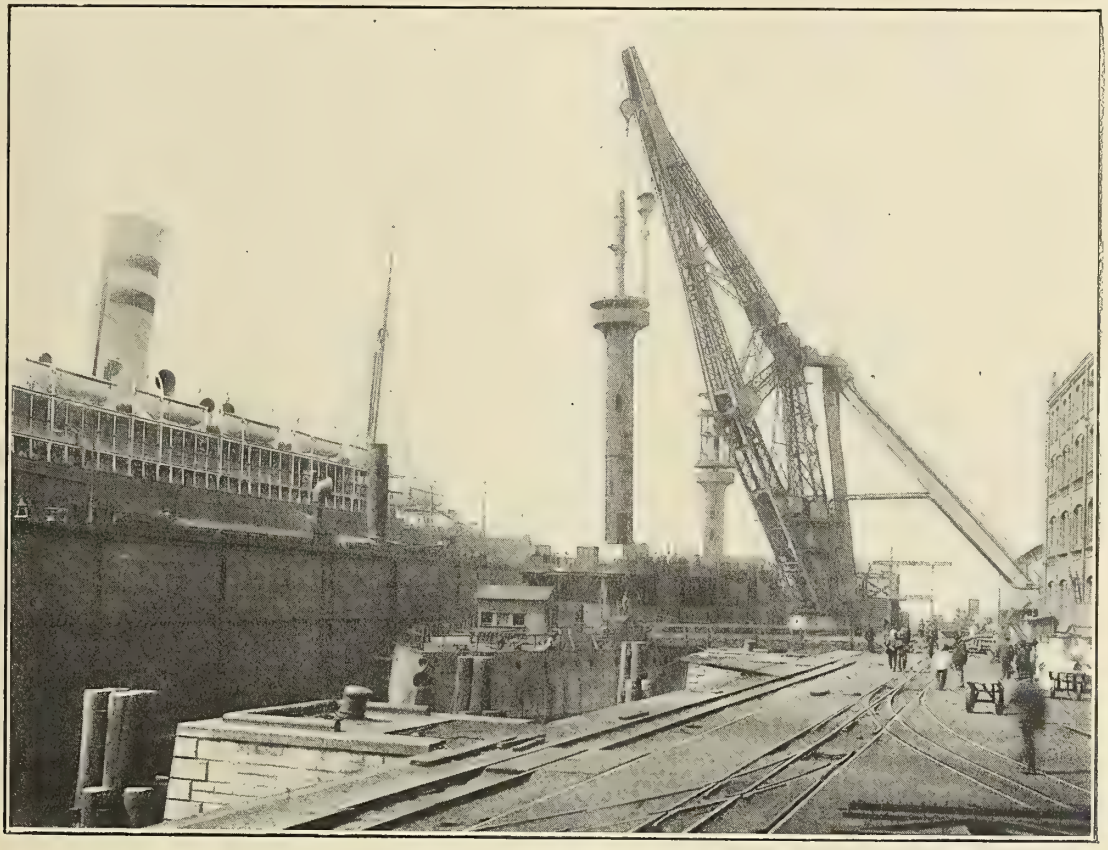


FIG. 3.—150-TON DERRICK CRANE, USED AT THE YARD OF BLOHM & VOSS.

It is certain that the single-motor crane is a type that is more and more coming into disuse. Its first cost may be lower, but in use it will be found dear, inasmuch as it has the same complicated and power-consuming gearing as the steam crane. The one large motor has to be in constant service, only the couplings being from time to time hitched on or off as occasion requires. Even for such movements as require less power, such as turning from right to left, or moving backward and forward, the big motor has to be at work, so that the proportion of work done and of current consumption shows a remarkably low rate. The simultaneousness of movement and hence the ease and speed in starting are naturally less in the case of the one-motor crane; in short, this type is only a clumsy makeshift, and not a rational and well-thought-out machine, as is the case with the three-motor crane. The service rendered by a crane is of such an eminently high order that in many cases even four-motor cranes are constructed. These have two motors for hoisting, one for heavy, and a smaller one for lighter weights, which can be raised with greater speed. So that one and the same crane may, with the utmost economy, be adapted to the treatment of loads of varying weights.

In reference to traveling cranes, it may be said that it was due entirely in the first place to the application of electric current that they have become the high type of power-driven hoisting machinery they now are. Here again it is the three- or four-motor crane which takes the first rank, both with respect to economy in handling and to the rapidity with which the various movements are effected. Even the very smallest types may now be

driven by power. The difference between the past and the present in this particular is really quite amazing; in old days the cumbersome treatment by hand power requiring several men, and nowadays the rapid handling by means of electricity under the control of but one man.

Most engineers hold that, where at all feasible, it is always advisable to employ continuous current as a motive power for cranes. The continuous-current series motor, which quite spontaneously works more rapidly in the presence of lighter weights and more slowly in that of heavier ones, is in every respect the one best adapted for this kind of work. But it needs to be specially constructed—that is to say, specially designed—for the work required of it. Where, for instance, 20 horse power may be desired, it by no means suffices to put down any ordinary 20-horse-power motor. A rule-of-thumb manipulation of this character might easily result in the loss of current of 30 per cent. or more. In the first place the degree of magnetic saturation of the motor plays an important part in relation to the work required. It is hence essential that each motor be adapted to the special kind of work and stand in exact relation to the requirements and not merely figured for the maximum output. Besides continuous motors three-phase current motors may also be employed for cranes. Three-phase current motors labor under the disadvantage of running most rational when the speed is a uniform one. For economic reasons special figuring and adequate dimensions will be in this case even more necessary than in the case of continuous-current motors in order that they may well correspond to the varying speeds.

The three chief movements are effected either by means of three reversing regulators, or in the case of the cranes manufactured at Karlsruhe by the Gesellschaft für elektrische Industrie, a universal crane controller is employed, which permits to perform two movements of the crane with one single steering lever. The zero position of this lever is the horizontal one; when moved upward the load is raised; if turned to right or left the load follows the same direction; if turned in an upward direction and to the right the load follows a corresponding movement; if a circle be described by the lever the load performs a circular movement. This steering apparatus resembles an ordinary railway controller, only it is constructed with two cylinders, which, through the medium of cogwheels, may be turned by the lever either singly or both at the same time. The resistance is mounted separately in each case. In some special cases the universal steering apparatus is provided with a third cylinder for the third movement, which is set in motion by means of a separate small lever. But in a general way the use of a special reversing regulator quite suffices for the third movement. In this way the man in charge of the crane can, by the aid of his two hands alone, direct the three movements of the crane simultaneously. All the movements are thus centralized and are directed by one man. In the case of traveling cranes, and more particularly where very rapid running is required, the steering apparatus is kept in the bunk immediately below the crane-man. The elevated position of the man in charge affords him an extensive view around the whole field of operation, thus enabling him to work rapidly and with distinct aim. It goes without saying that good quality and durability of the steering apparatus on the one hand, and on the other hand its exact adaptation to the requirements of each individual case, are most important factors in the successful handling of cranes on a large scale. It is a necessary condition of rapid manipulation that the steering apparatus be graduated to a fine scale. Well-constructed cranes must deposit their loads upon the desired spots to within half an inch, straight away and without any prior bungling, uncertain attempts. In order to more fully insure this result the starting gear of all the cranes is provided with automatic electro-magnetic brakes. These brakes, as built at Karlsruhe, are lifted automatically the very moment the motors are connected, and begin to act at once as soon as the motors are disconnected. So long as the crane is idle all the brakes are in this way in full action; hence it follows that the arrest of movement is instantaneous. Furthermore, these brakes afford every guarantee in case of any hitch in the working. Should, for instance, the current from any cause suffer momentary interruption, the brake magnets would in that case become at once discharged of all current; they would immediately come into action and the counterweight hold the load fast where it was. For small cranes working at high speed, worm gearing is sometimes employed, the steel worms being cut out of the block, tempered, and ground; and milled worm wheels are often made of phosphor-bronze. Large cranes are sometimes fitted with rawhide gearing. All such parts as are brought frequently into operation are made of cast steel. The material used for raising and lowering weights varies according to the nature of the work. Either Gall's chains or steel ropes are employed. The hook of the crane runs in ball bearings, so that the chain or rope never gets twisted.

Feed Water, for Marine Water-Tube Boilers.

Water tube boilers require somewhat more care, both as to water tending and as to the character of the feed water, than do Scotch boilers. The care required to keep the proper water level will depend in a great measure on the area of the water line. With a relatively large area, sudden fluctuations are not as likely and the height of water can be more easily regulated. Nearly all express boilers and some of the large tube type are fitted with automatic feeding devices which in a great many cases are unsatisfactory. Whatever device is installed it should be so fitted that in case of breakdown it may be readily disconnected and the regulation done by hand.

With a battery of boilers, the general practice is to keep the feed pumps going continuously at a certain pressure by regulation at the pump, and then taking the water as needed at the boilers. In water tube boilers, especially those provided with feed heaters in the casing, the feed should be continual, and should never be entirely shut off as long as the boiler is furnishing steam. When the boiler is steaming and the feed shut off even for a short time there is the danger of some of the heating surface, especially in feed heater, becoming free of water and burning. A constant feed even of small volume will ensure all the proper parts being full of water.

FEED WATER.

The nature of the feed water should be most zealously watched, for it is the most important matter in connection with the proper working of the boilers. The feed should be clean, free from salt, oil, air, and should be as warm as possible.

Ordinary dirt can, of course, be kept out of the feed without any great difficulty. To prevent salt from entering is something much more difficult. In the first place there must be tight condensers and valves, to prevent any possibility of salt water mixing with the fresh, and to detect any leaks at the earliest possible time the water in the hot well must be frequently tested, so that measures to stop leakage may be immediately taken.

The pumps regularly used for pumping boilers should have no sea connections whatever, for it is by means of opening wrong valves and not properly washing out pumps after using them on bilge or sea, that salt finds its way to the boilers.

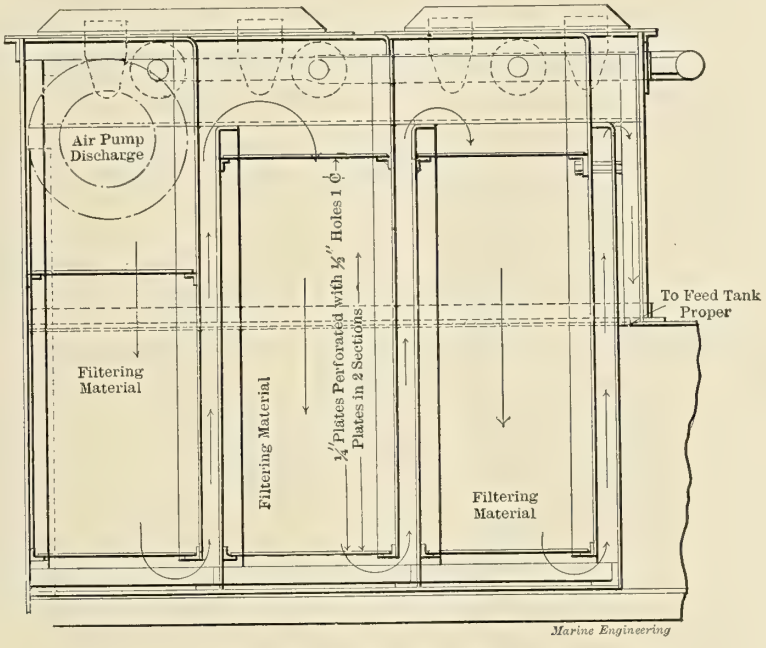
The best way to prevent oil from entering boiler is not to use any for internal lubrication, nor install auxiliaries having the forced feed lubrication enclosed type of engine. Even then oil will get into the exhaust from swabbing the piston rods and efficient grease extracters should be supplied and feed tanks provided with filter beds.

To keep air entirely out of the boilers is practically impossible, but its amount should be reduced to a minimum. This is done by, (1) keeping feed tank partly full at all times; (2) providing a float valve in feed tank which will close when water gets below a certain level; (3) having no leaks on suction side of pump by which air can be drawn in; (4) providing feed tanks with vapor pipes, thus facilitating the escape of air to the atmosphere; (5) keeping water in tank warm, since hot water does not contain near the amount of air that cold water does; (6) providing feed heaters with air cocks through which accumulated air may be blown out.

Air is one of the chief causes of corrosion in boilers; in combination with hard oil deposit it forms a crust on the heating surface making it rough, favorable to the collection of dirt and to corrosion; also the deposit diminishes the efficiency of the heating surface and the danger of burning the tubes.

NAVAL FILTER TANKS.

In naval practice the feed or hot well tanks are provided with a filter chamber located in the upper part of the hot well tank. A general type of which is herewith shown. The air pump discharge opens into tank at one end and the water flows through the filtering material as indicated by the arrows and then to feed tank proper.



NAVAL TYPE OF FEED-WATER FILTER.

Covers on top of the tank may be raised and then the perforated plates between which the filter bed is held removed, so that the whole tank can be easily cleaned.

The filtering material is of different kind; sponges soon rot and are expensive, excelsior and other material of a similar nature is sometimes used, but a very satisfactory material and one that can be readily obtained on board ship is coke. A handy arrangement is to place the coke in bags of convenient size made of coarse toweling or of a good grade of burlap. This allows the tank to be cleaned and the filtering material to be renewed with facility. Coke can be made in the fire room as it is needed and there is thus no need of stowage space for filtering material, which should be replaced at least once every three weeks and if considerable oil is used in engines, it should be done oftener.

Such an arrangement of filter can be easily installed on any vessel and if properly used will help out the efficiency of the boilers wonderfully. SUBSCRIBER.

Keys and Keyways in Shafting.

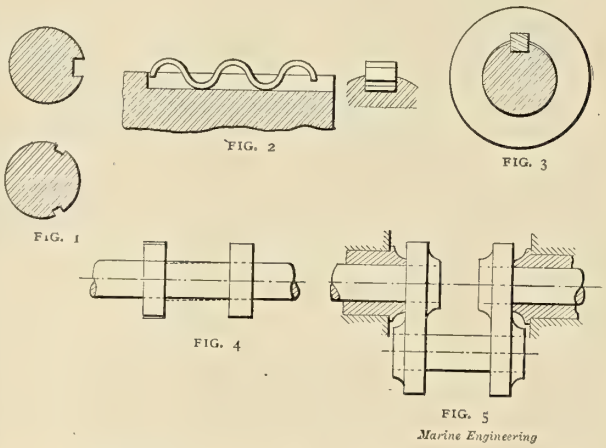
Where shafts are provided with independent couplings, either shrunk or forged on, they are generally held from turning in those couplings by either one or two keys. The key should be so proportioned that its shearing strength is slightly more than the twisting strength of the shaft. It must, therefore, have a width, which multiplied by its length will give the right sectional area in a plane tangent to the surface of the shaft as required by the strength of the shaft. Where only one key is used, it is poor practice to make it narrower than one-fourth of the diameter of the shaft, and the length should be proportioned to suit. On shafts of 8-inch diameter and above it is the practice to use two keys. Then the combined shearing strength of the two should be somewhat greater than the twisting strength of the shaft. Thus while the combined width of the keyways is no less than the width of the single keyway, the depth of the keyways is less, and therefore there is not so much metal cut out of the shaft for the two keyways as there is in the shaft with but one keyway, which means that the shaft with two keys is stronger. This is evident by reference to Fig. 1.

There is one difficulty against more than one key, which is the fitting of the keyways in the shaft and coupling, so that they will exactly correspond. If this is not the case, all the strain will be taken up by one key only, in which case the other key becomes useless. This is especially true where it is the practice to drive the keys when shrinking on the coupling, and before it is cooled off. In this case the keyways will have to be fitted very exactly, in order to come true. This, however, is a very poor practice, especially if the key should be made too full in depth, when it will prevent proper contact between the bored surface of the coupling, and the shaft, and will throw them slightly eccentric with each other.

A better method is to shrink the coupling on, using only a blind key, in order to get the keyways in line with each other. A blind key can best be made out of sheet metal, making the width to fit the keyway, and bending it as shown in Fig. 2. This strip of metal is laid into the keyway of the shaft, so that the corrugations project above the surface, and after the coupling is shrunk on, it can easily be drawn out. By using this method, the keyways can be finished after the shrinking process, and an even bearing may be secured for the key. This form is more expensive than the former method, as the keys and keyways will have to be fitted very exact, in order to get even contact, while the manufacturers who shrink their keys in, depend upon the elasticity of the metal to find its own seat. It would seem to some, that, when the hub of a coupling on the web of a crank is shrinking down to its original size, a key, which is too full, would hardly prevent it from doing so, as the amount of metal in the key is comparatively little if compared with the amount contained in the hub, and thus the key should in such a case be crushed. This, however, is not the case, as the crushing strain of a metal, which is prevented from spreading, by being held in a tight fitting and sufficiently strong enclosure, is almost unlimited. Besides this, the metal in the hub is not subjected to direct tension, in fact the stresses are partly bending stresses; also the metal, being heated, is in a more malleable state than that of the key.

The key can, however, prevent the proper contact, all around the joint, without being too full, as in a case where the corners of the key and keyways are slightly rounded, and such fillets are not fit properly; also if the key is made to fit very tight sideways it is liable to bend sufficiently on the sides of the keyway, to prevent the coupling from shrinking in its true cylindrical form. The result of any of the above faults are illustrated in an exaggerated condition in Fig. 3.

The writer has seen crank webs, on several built-up crank shafts where the keys which were driven while the webs were hot had worked loose; in all cases the condition of the joint indicated that there had been no contact for a large portion of the circumference of the



joint on either side of the key. In two cases, where two keys were used, the condition was so bad, that there was absolutely no contact between the keys, in fact the crank web bore only in three places, *i.e.*, on each key, and at a point half way between the keys and extending for about 1-16 of the circumference of the shaft on either side of this point. Of course, these are rare cases.

While some forms of hull construction offer a saving of weight over other forms and there are many ways where a good hull designer may cut down weights without materially weakening the structure, the machinery does not offer the same possibilities for reducing weight.

No accident has ever happened to an engine while it is on the drawing board, unless somebody should spill a bottle of ink over it; consequently the average designer will feel quite encouraged to "pinch" a little on the crank webs, for instance, in order to get a little more length added to his bearings, or worse still, to increase the length of the crank pins, so they will not run hot.

I can already see some of your readers smile about such ignorance as to oppose the increase of the length of a crank pin, but the writer has had some serious experiences with long crank pins on fore-and-aft compound engines.

In one case a builder had a contract for two 14 and 28 inches by 20 inch cross compound engines, left and right, for a twin screw steamer. The capacity of his shop as well as his finances were not any too great, and as he had plenty of time, he concluded to build one

engine at a time. The crank shaft of the first engine was a solid forging, and when the engine was started and tested, it worked beautifully. When the forging for the second shaft arrived, which was about two months after the other parts of the engine were finished, he found to his great dismay, that it contained a flaw, and therefore was useless. The time to deliver the second engine began to draw near, and the managers of the forging works could not promise a new shaft for some time, being overheaped with work. The engine builder thus decided to make a built-up shaft for the second engine, and when the engine was tried, it was found that the low pressure crank pin would run hot. As the shaft had been tested for alignment before being put in place, it appeared to be quite a puzzle, as the pin was actually flooded with oil.

Upon examination it was found that the low pressure pin would be canted as indicated by the dotted lines in Fig. 4, every time the high pressure was on the stroke and resulted in a perceptible twist on the low pressure connecting rod; by increasing the break load, even the crosshead pin began to warm up. When the crank brasses were dismounted it could plainly be seen where the pin bound, every time the crank pressed the center, and after removing the shaft, it could be seen that the pin had been working in the webs, and would have eventually worked loose altogether.

The writer then suggested that the crank webs be made as shown in Fig. 5, with increased thickness where the crank pins and journals were shrunk in; this could be done as the ends of the bearings were overhanging considerably. The new webs were fitted and when the engine was again tested, the crank pin behaved just as good as the one of the solid shaft.

There is also danger of the above kind, if the crank webs of a solid shaft are made too thin, as they are liable to twist then by the same action of the pin

When a crank pin is shrunk into the web, there is very little danger of its turning, as the friction of the brasses amounts to but very little as compared with the friction of a shrinking fit, consequently the expense of fitting a key may be avoided.

A very good method of keying a crank pin is to drill and tap the joint, which is very inexpensive, and will prevent the pin from turning or from working out.

This process is done by drilling a hole in the pin and web, so that one-half of the hole is in the pin and the other half in the web. Into this hole a standard bolt thread is tapped, and a tight fitting bolt screwed, which may then be cut off flush with the crank web. This method is adopted by many builders, but by using three such tapped keys, its security is greatly increased, especially if the bending action on the pin is very great. The three keys should be spaced at angles of 120 degrees and if the job is done properly, such a pin is almost equal to a pin forming a solid piece with the web.

H. E. R.

British Shallow Draft Gunboat.

There was recently tried an interesting shallow draft gun-boat, *H. M. S. Widgeon,* built by Yarrow & Company, Ltd., Poplar, to the order of Admiralty. The vessel has been designed specially for operations in shallow water and is fitted with a device, introduced by the builders, to enable high propulsive efficiency to be obtained with various conditions of draft. This arrangement, which has already been described in MARINE ENGINEERING,* consists in placing the propellers in longitudinal inverted troughs, the crest of which is above the water line, while the ends and sides are below the surface, even when the vessel is light. The propeller thus has a space to revolve in wholly above the line of the keel, which makes the arrangement specially suited for shallow draft navigation. When the screws revolve the air is driven out of the tunnel and the water, rising to fill the vacuum thus caused, keeps the screws fully immersed. It is evident that the rear slope of the tunnel down to the water line offers considerable resistance to the wake thrown from the propeller, and also that this slope is unnecessary when the vessel is loaded, as its only purpose is to maintain the vacuum by being immersed and so preventing air rising in the tunnel. In order to overcome this resistance when the vessel is deep laden, Messrs. Yarrow & Company have introduced a hinged flap, which forms the back part of the tunnel. At deep draft this is completely raised, and it is lowered as the vessel comes up in the water owing to consumption of fuel and stores or from any other cause. In this way an unobstructed flow to the propeller race is obtained, and yet a vacuum is secured in the tunnel at any draft.

The trials mentioned were designed more especially to test the efficiency of the device, and were carried out in the estuary of the Thames. They consisted first of a six hours' run at 11 knots, and a two hours' run at 13 knots. These two runs were made consecutively without a stop, the actual speeds being 11.030 knots and 13.058 knots respectively. The latter speed is remarkable, considering the draft was no more than 2 feet 8 inches. These runs were made with the flap up, the vessel being fully laden. An hour's run was then made with the flap down, the conditions in all other respects being as on the two hours' trial. The speed came out at 12.218 knots. It will, therefore, be seen that by means of the flap the speed of the vessel on full draft was raised more than four-fifths of a knot over what it would have been under the old conditions.

The *Widgeon* is 160 feet long and 24 feet 6 inches wide, the depth of hull being 6 feet. For facility of transport she has been constructed in sections not exceeding 18 feet in length fore and aft, each section being capable of floating by itself. These sections are so arranged, by means of deep floors or low bulkheads, that they can be bolted together in the water, and the complete vessel thus be built up afloat. The machinery space is protected by chrome steel armor of sufficient thickness to be bullet proof at a point-blank range of 20 yards. On the upper deck there is an armored battery 78 feet long, also protected by hard steel armor. Here are mounted two 6-pounder q. f. guns and four rifle calibre (.303) Maxim machine guns. There is also an armored conning tower forward.

The engines are of the compound condensing type, and the boilers are the Yarrow straight water-tube description. There are a steam windlass, with special warping arrangements for hauling up rapids, steam steering gear, and other auxiliaries.

*See MARINE ENGINEERING, October, 1902, page 506.

Fire and Loss of Life on the General Slocum.

On June 15, the excursion steamer *General Slocum*, well known in the waters of New York, took fire on the East river at a point about opposite 90th street, while going up the sound with an excursion from New York Sunday schools. The flames quickly spread over the entire vessel and fearful loss of life resulted. Most all of those on board were children and their mothers. The captain headed the ship for North Brother island, where she grounded and sank after all the upper works had been burned down. The loss of life has, at the time of writing, reaches nearly 900, and it is probable that there are 200 more victims of the accident.

The *Slocum* was built of wood throughout, but according to the rules of the United States Steamboat Inspection Service. She was 236.3 feet long, 38 feet molded breadth, 12.4 feet deep, and of 1,284 gross tons. She was driven by a single-cylinder walking-beam engine, the hull and machinery built in 1891. Above the main deck were two wooden decks from stem to stern. In the hold forward of the boilers was the lamp room, in which was stored the oils, paints, and other inflamable material, and it is in this room that the fire broke out. It is stated by one of the crew that a crate of glassware packed in straw was stowed in this room just before the fire was discovered. The deck hand notified the mate of the fire and one fire hose was coupled up and the pumps started. It is stated that the passengers in endeavoring to help with the hose kinked it in several places and that it broke before the water ever reached the nozzle. The flames gathered headway rapidly and swept aft with fearful speed, driving the passengers and crew either to the decks above or overboard. It was not long before the upper decks were ablaze forward, and fanned by the head wind the flames drove the helpless women and children to the rails or suffocated them. Such wild scenes of confusion, panic, and horror, related by the survivors, have never before been recorded. The life preservers, which were distributed to some extent by a few of the crew to the terrified passengers, in many cases proved to be death traps, as there was no buoyancy in them, and they carried the victims to the bottom.

Three investigations are at present underway, the one by the Steamboat Inspection Service is being personally conducted by Secretary Cortelyou of the Department of Commerce and Labor, and as evidence accumulates it looks at present writing as if the inspectors had not properly performed their duty, although a certificate of inspection was issued on May 7, 1904, allowing the *Slocum* to carry 2,500 passengers. The coroner of the Bronx, New York city, is bringing all the evidence that he can find before a coroner's jury composed of specially high-class men. The district attorney of the city is also accumulating evidence to see if there is a case of criminal negligence against the owners, the Knickerbocker Steamboat Company. This case, from the evidence to be brought out, it is to be hoped, will have most far-reaching results both in the improvement of the inspection service and the remodeling of the rules and regulations of that service.

THE EXCURSION STEAMER GENERAL SLOCUM, DESTROYED BY FIRE, AND BEACHED ON NORTH BROTHER ISLAND.

[Photograph by the New York Tribune.]

Report on Oil Fuel.—The so-called Liquid Fuel Board of the engineering corps of the navy, composed of Commander John R. Edwards and Lieutenant-Commanders W. M. Parks and F. H. Bailey, have submitted their report concerning the use of liquid fuel aboard ship. The report is based on extended experiments with different grades of oil, and different makes of burners, with natural and forced draft. The conclusions are that many of the supposed hindrances to the use of oil on shipboard have been done away with; that crude petroleum was found not to give as good results as after it had undergone a slight refinement; that the simplier the furnace the greater its efficiency; that forcing a boiler with oil fuel is much more readily accomplished than with coal. Concerning use on war ships, the board recommends that oil of a flash point not under 175 degrees F. should be used. This higher point required for naval vessels than for merchant ships is essential for the following reasons: War vessels must be kept in readiness to proceed to the tropics on immediate notice; the firing of guns subject naval ships to special dangers; because of numerous subdivisions on naval vessels it is extremely difficult to properly ventilate certain compartments; as a large number of men must be housed below decks it is difficult to prevent the use of open lights.

LAUNCHING THE UNITED STATES CRUISER CALIFORNIA.

BY E. P. LESLEY.

On April 28 the armored cruiser *California* was successfully launched from the ship yard of the Union Iron Works in San Francisco. The *California* is 502 feet long on the water line, 61 feet 6 1-2 inches beam, 24 feet draft, and 13,400 tons trial displacement. The required speed is 22 knots. The main battery consists of four 8-inch breech-loading rifles, mounted in two eliptical turrets, one forward and one aft, and a broadside battery of fourteen 6-inch breech-loading rifles, mounted behind 5-inch armor. The secondary battery is composed of eighteen 3-inch rapid-fire guns, twelve 3-pounder semi-automatic guns, four 1-pounder heavy automatic guns, four 1-pounder heavy rapid-fire guns, two 3-inch field pieces, six automatic guns, 0.30 caliber, two machine guns, 0.30 caliber, and two submerged torpedo tubes. The side armor is 6 inches thick amidships and tapered to 3 inches at the ends.

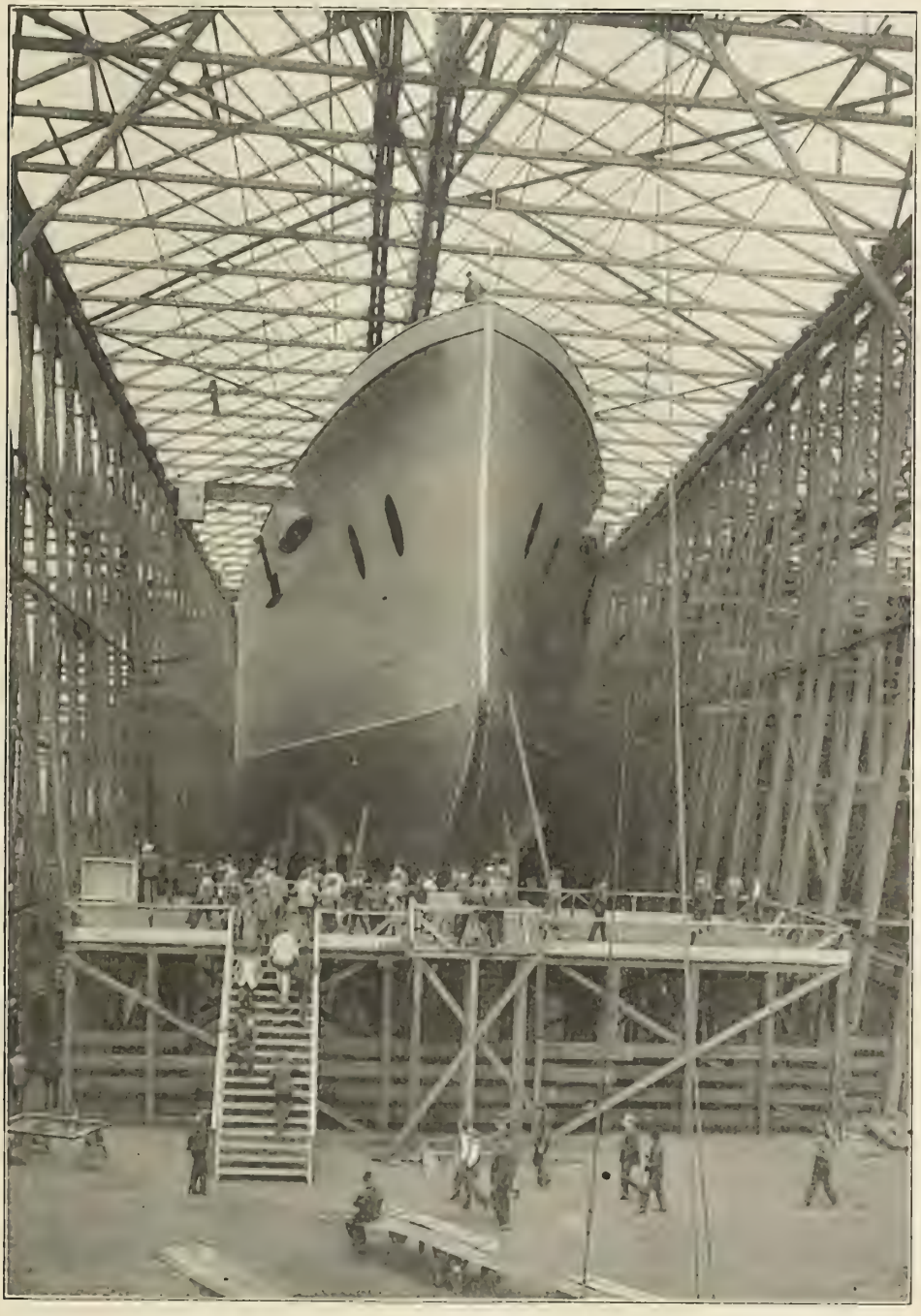


FIG. 1.—THE UNITED STATES ARMORED CRUISER CALIFORNIA, READY FOR LAUNCHING FROM THE YARD OF THE UNION IRON WORKS, SAN FRANCISCO, CAL.

A new device for releasing the ship was used at this

launch. An inclined track (Fig. 2) was built between the double ways on each side of the ship. At the bottom of this track stood the trip shore, *B*. This shore was knocked out by a blow from a 300-pound weight fixed to a carriage that was held at the top of the track by a trigger controlled from the launching platform. When released this carriage moved down the incline and the trip shore, which holds the dog shore in position, was knocked clear. Immediately the dog shore fell, and the ship was free to move. This device worked most successfully.

Some interesting data regarding launching velocity was obtained by use of a chronograph (Fig. 3) designed for this purpose by the writer. A fine steel wire, wound

velocity, acceleration, and kinetic energy may be plotted, and from these the coefficient of friction may be determined.

The launching weight of the *California,* including the launching cradle, was 5,820 tons. The start was very slow, the ship moving but 9 inches in the first ten seconds. From this point the velocity rapidly increased, attaining a maximum of 22.1 feet per second at 41 seconds from the start and after a travel of 320 feet. The total distance traveled was 784 feet and the time from start to finish 76 seconds. The lubricant used was tallow 939 pounds, sterine 416 pounds, and soft soap 929 pounds. The coefficient of friction determined from the chronograph record of launching velocity was 0.0197.

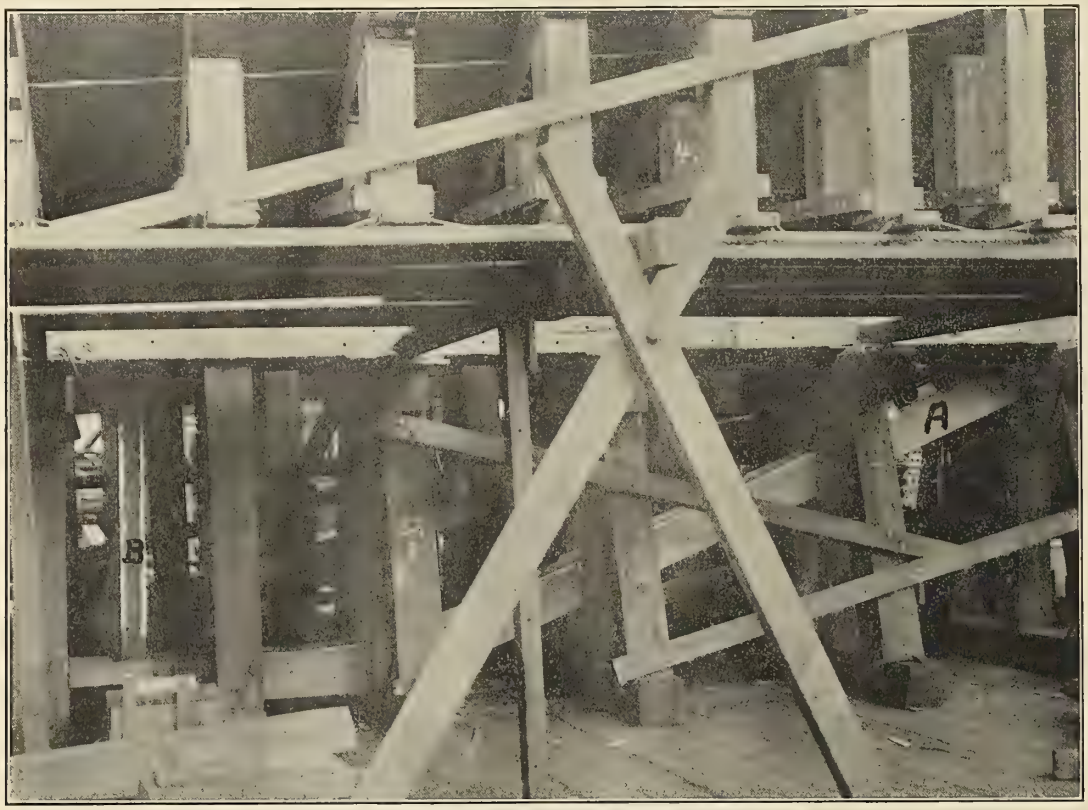


FIG. 2.—NEW RELEASING DEVICE USED IN THE LAUNCH OF THE CALIFORNIA.

in one layer on the drum *A,* was attached to the ship. The drums *A* and *B* are so proportioned and geared together that a motion of the ship of one foot is shown by a motion of the surface of the drum *B* of 1-2 inch. A small carriage, *C,* carrying an electro magnet, is moved along the drum *B* by means of a screw shaft. A tracing point, hinged from this carriage, traces a line on a piece of paper wrapped around the drum. A metronone, gauged to beat 1-2 seconds, is used to make and break the circuit actuating the magnet. At each closing of the circuit the tracing point is drawn sharply to one side and thus a notched line is produced. The interval of time between two consecutive notches is 1-2 second and the distance between two consecutive notches is the travel of the ship for that half second, the scale being 1-2 inch to the foot. From the record thus produced, which covers the entire travel of the ship, curves of

Alcohol as a Motor Fuel.

House Bill 9302, introduced by Hon. Henry S. Boutell, of Illinois, in the last Congress, was intended to give the users of domestic alcohol for industrial purposes in this country the same exemption from internal revenue taxation that is granted in foreign countries The enactment of this bill would provide an abundant supply of a safe and economical motor fuel, at a price as low as, if not lower than, the cost of gasoline. The benefits which would result from such legislation are so manifest that the adoption of such a measure should be urged by every manufacturer or user of automobiles, power launches, or motor engines.

This measure has absolutely no connection with the question of the importation of foreign alcohol. It is not intended to interfere in any way with the present duty on imported alcohol. The material which it is pro-

posed to free from the present excessive internal revenue tax is alcohol made in this country from materials grown by our farmers, which has been rendered unfit for use as a beverage. The movement is therefore in no sense partisan or political. The chief obstacle to the enactment of this bill is the opposition of the wood alcohol interests, who are now enabled to sell their inferior product at a large profit by reason of the fact that it is not taxed.

In view of the hoped for legislation, it is well to call attention to properties of alcohol which make it such a decidedly satisfactory substitute for gasoline as a motor fuel, and its superiority in many important particulars.

It is clean, odorless and free from danger of accidental explosion. The vapor given off is not inflammable unless closely confined, and naked lights can be used around the machine with impunity. The worst danger to be apprehended from a leak in the pipe or storage tank would be the loss of the fuel, or a slow fire if a flame came into actual contact with the alcohol.

The supply is absolutely unlimited. Alcohol can be obtained from all substances containing sugar or starch, or compounds which can be transformed into sugar, such as corn, grains of all kinds, potatoes, cane and beet sugar refuse, grape skins and refuse of wine making, etc., etc. Increased demand can only have the effect of increasing production, and stimulating efforts to perfect and cheapen processes of distillation and distribution.

In countries where it is not made artificially dear by taxation, alcohol is rapidly taking the place of gasoline and other petroleum distillates, as a fuel for explosive motors of all kinds. In all the leading European countries alcohol made undrinkable by officially prescribed processes of denaturization is tax free.

The use of alcohol as a fuel is prevented in this country by an internal revenue tax equal to more than 1,000 per cent. of its cost. Under the present tax alcohol is fifteen times as costly as gasoline at its present price. If the tax on alcohol were removed it would be as cheap as gasoline, if not cheaper, and would be the best fuel for explosive engines.

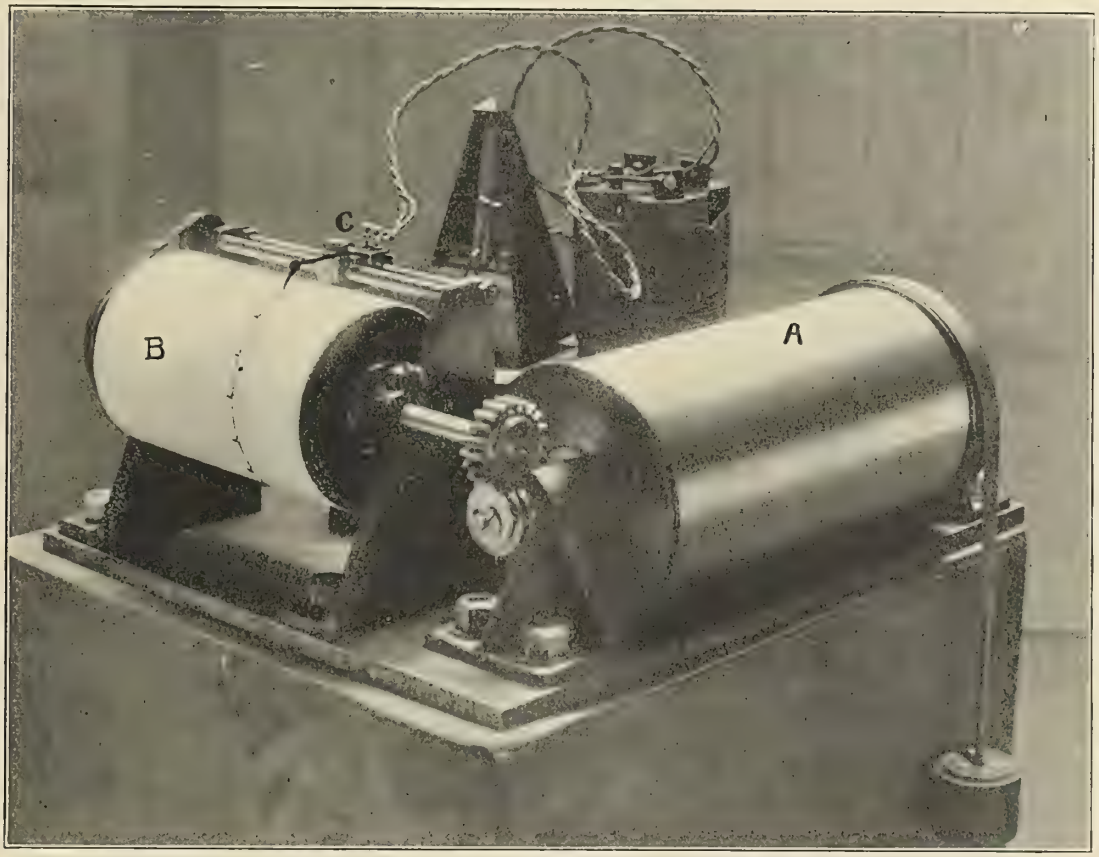


FIG. 3.—CHRONOGRAPH, FOR RECORDING THE VELOCITY OF THE SHIP AT DIFFERENT PERIODS OF THE LAUNCH.

Alcohol is being used very extensively in both France and Germany as a motor fuel. It is stated that although alcohol has a lower thermal value than gasoline, yet it has been demonstrated that its proportion of convertible heat units into work, to the total heat supplied (efficiency) is greater than gasoline. The explanation for this unusual statement is that the conditions in a combustion chamber of an explosive engine are such that only a small percentage of the heat energy of a rich fuel is utilized, whereas the conditions are highly favorable for the transformation of a larger percentage of the heat units of a fuel such as alcohol, and especially so when it is hydrated, *i. e.*, mixed with water,

TRIAL OF THE UNITED STATES REVENUE CUTTER MOHAWK.

The new revenue cutter *Mohawk* has, after many delays in her construction, been finally completed, and on February 6, 1904, was given her official trial trip in Chesapeake bay. The contract for the construction of this vessel was awarded to the William R. Trigg Company, of Richmond, Va., at its bid of $217,000, on April 20, 1900. She was to have been completed within twenty months from the date of the contract, but the financial embarrassment of the builders and the subsequent legal entanglements have delayed the finishing of the new cutter until the present time.

The new vessel is, in general appearance and dimensions, almost a duplicate of the *Onondaga* and *Algonquin*. Her rig is that of a two-masted schooner, and she will carry only sufficient fore-and-aft sails to steady her in a beam wind, or to heave to in a gale. The stem is ram-shaped, and throughout her construction is such that she may easily be transformed into a fast and serviceable gunboat in time of war, as she can carry six 4-inch breech-loading rifles and the usual secondary battery for vessels of her class.

The framing and plating is of mild open-hearth steel, the physical requirements of which were a tensile strength of not less than 55,000 pounds per square inch, and an elongation of 25 per cent. in 8 inches. The transverse frames, except at the extremities of the vessel, are of Z-bars, 5 by 3 by 3 inches by 12 pounds per linear foot, and spaced 24 inches between centers. The stem, stern post, and rudder frame are of the best hammered wrought iron. The main-deck beams are formed of angle bars, 6 by 3 inches by 12 1-3 pounds per foot, with a camber of 7 inches in 32 feet. There are accommodations provided for a crew of 60 men and 8 officers. The principal dimensions of the hull will be found in the data card, page 322.

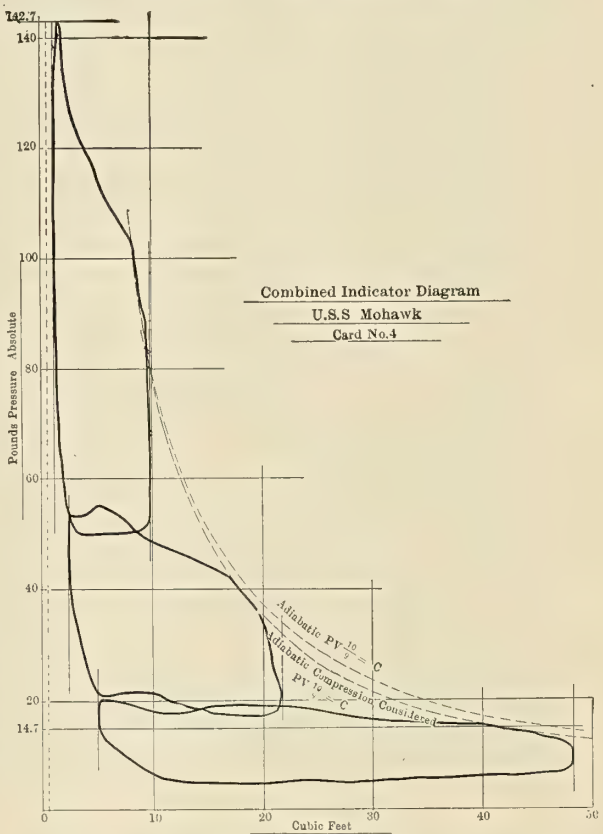
MACHINERY.

There is one vertical, inverted, direct-acting, triple-expansion engine with cylinders 25, 37 1-2, and 56 1-4 inches in diameter, respectively, having a common stroke of 30 inches. Each cylinder is fitted with hard, close-grained, cast-iron liner, and the I. P. and L. P. cylinders are steam jacketed. The valve gear is of the Stephenson link type, working a piston valve for the H. P. cylinder, and double-ported slide valves for the I. P. and L. P. cylinders. The I. P. and L. P. valves are assisted by counter-balance cylinders which are piped directly to the main condenser. The cut-off for each valve is adjustable by means of slotted reversing arms.

The main pistons are of cast steel, conical, and each is fitted with two hard cast iron packing rings 5-8 inch wide by 3-4 inch thick. The high- and intermediate-pressure packing rings are each made in six, and the low-pressure rings in eight sections, the joints between all sections being made with brass tongue pieces. Each cylinder is supported at the front by a forged steel column 6 inches in diameter. At the back they are supported by short cast iron columns which are bolted at the bottom to facings cast on the main condenser. Hollow guides for water circulation are bolted to the back columns. The bed plate is of cast iron in one piece. The top of the engine foundation is formed of one steel plate 3-4 inch thick, which is also extended aft, and forms the top of thrust bearing foundation.

The main condenser is in three sections bolted together, and forms a part of the framing of the main engine. Openings are provided for the main and auxiliary exhaust pipes, supplementary feed, evaporator discharge, soda tank, air pump suction, and boiling-out nozzle.

The reversing gear is of the ordinary direct-acting type, consisting of a steam cylinder bolted to the bed plate at the front and connecting to double arms on the reverse shaft. There is a hand-turning gear operated by a ratchet lever in conjunction with a worm and wheel secured to the shaft aft of the thrust bearing.



COMBINED INDICATOR DIAGRAM, TAKEN ON REVENUE CUTTER MOHAWK.

On page 322 will be found the data for the principal dimensions of machinery, and below are given further particulars of main engine and condenser:

Diameter of H. P. valve, 16 inches.

Dimensions of I. P. slide valve, 2 feet 11 11-64 inches by 3 feet 1-2 inch.

Dimensions of L. P. slide valve, 3 feet 4 5-8 inches by 4 feet 8 inches.

Area H. P. steam ports, maximum opening, top, 59.96; bottom, 64.12.

Area I. P. steam ports, maximum opening, top, 101.0; bottom, 108.0.

Area L. P. steam ports, maximum opening, top, 202.0; bottom, 220.93.

Main steam pipe, diameter, 9 inches.

Exhaust pipe, I. P. to L. P. cylinder, diameter, 14 1-2 inches.

Exhaust pipe, L. P. cylinder to condenser, diameter, 19 inches.

Ratio of net area of H. P. to I. P. piston, 1 : 2.26.

Ratio of net area of I. P. to L. P. piston, 1 : 2.25.

Ratio of net area of H. P. to L. P. piston, 1 : 5.06.

Main condenser, length over all, 16 feet 5 1-4 inches.

Width, inside, 2 feet 1-2 inch.

Length of tubes, 14 feet 5 inches.

Number of tubes, 1,217.

Diameter of tubes (outside), 5-8 inch.

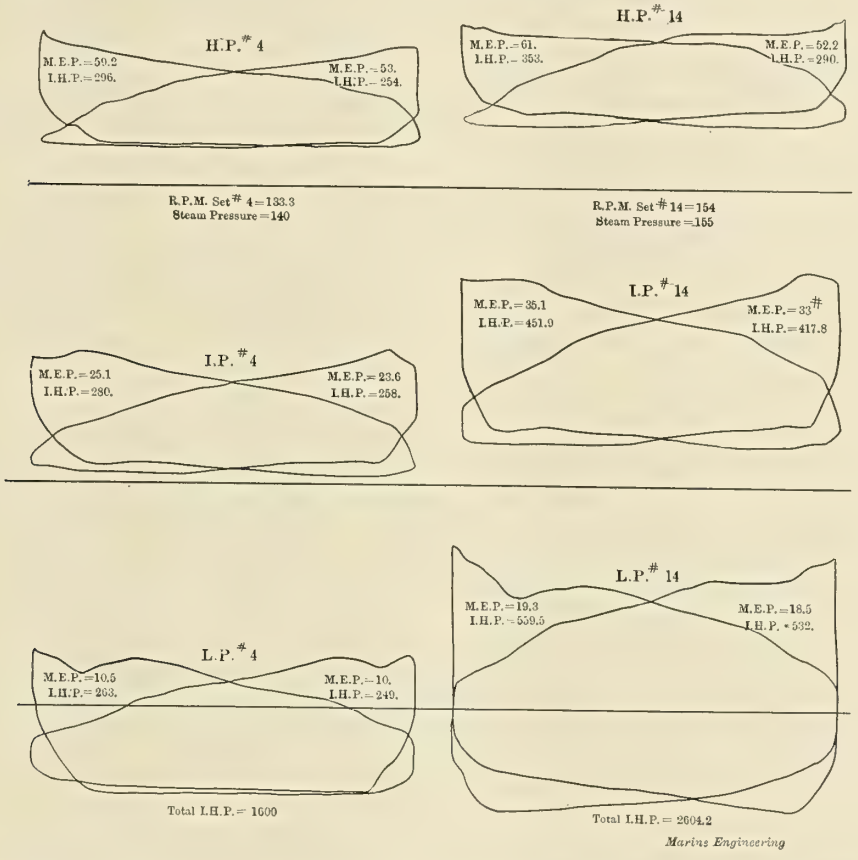
Cooling surface, 2,870 square feet.

system, having two direct-acting steam cylinders, each 9 inches in diameter, and two air cylinders, each 20 inches in diameter, the common stroke being 12 inches.

One independent centrifugal circulating pump operated by a steam engine having a cylinder 8 inches in diameter by 8 inches stroke, the diameter of the suction and discharge nozzles of the pump being each 10 inches.

One vertical duplex main feed pump, having 8 inches diameter of steam cylinders, 5 inches diameter of water cylinders, and 12 inches stroke, located in the engine room.

One auxiliary feed pump of the same pattern and dimensions as the main feed pump, and also located in the engine room.



SET OF CARDS AT NATURAL AND FORCED DRAFT, TAKEN ON THE TRIAL OF THE UNITED STATES REVENUE CUTTER MOHAWK.

There are four single-end Scotch boilers, arranged in pairs in one water-tight compartment, with a single athwarship fire room between them. Forced draft of the closed fire room system is provided. The shell of each boiler is composed of only two plates. The longitudinal seams are double butt-strapped and treble riveted, while the two end circumferential seams are lapped and double riveted. Each boiler has two Fox's corrugated steel furnaces; the tubes are of seamless drawn steel. The dimensions will be found on the data card.

AUXILIARIES.

The new vessel is fitted with a very complete system of auxiliaries, which consist essentially of the following:

One independent air pump of the vertical twin-pump

Two boiler feed injectors with flanged connections, of the Metropolitan type, No. 14 1-2.

One horizontal bilge pump, having a steam cylinder 6 inches in diameter, a water cylinder 8 inches in diameter, and a stroke of 10 inches.

One vertical duplex fire pump, which is also used to operate the ash ejector, and as an emergency circulating pump, having steam cylinders 14 inches diameter, water cylinders 8 1-2 inches, and a stroke of 12 inches.

One general service pump of the vertical duplex type, having steam cylinders 7 1-2 inches in diameter, water cylinders 5 inches diameter, and 8 inches stroke. This pump can be used for fire, washing down decks, circulating water through distiller, and for bilge purposes when necessary.

One combined fresh- and salt-water pump for the distilling appartus, having a steam cylinder 3 1-2 inches in diameter, a fresh-water cylinder 2 1-8 inches in diameter, a salt-water cylinder 2 1-8 inches in diameter, and a stroke of 4 inches.

One combined feed-water heater and auxiliary condenser, having 240 square feet of tube surface. This apparatus, when used as an auxiliary condenser, is operated by a combined pump, having a steam cylinder 6 inches in diameter, an air cylinder 6 inches in diameter, a circulating cylinder 6 inches in diameter, and a stroke of 6 inches.

In connection with the sanitary system of the vessel there is a flushing pump for closets, having a steam cylinder 4 1-2 inches in diameter, a water cylinder 4 3-4 inches in diameter, and a stroke of 6 inches. There is also an air-compressing pump which forces air into a cylindrical fresh-water tank for supplying wash basins and bath tubs. This pump has a steam cylinder 4 1-2 inches in diameter, an air cylinder 5 1-2 inches in diameter, and a stroke of 4 1-2 inches.

The forced-draft system is operated by two fans, 50 inches in diameter, each fan being run by a pair of steam cylinders 5 inches in diameter by 5 inches stroke.

The steam-steering gear is operated by two steam cylinders, each 4 1-2 inches diameter by 4 1-2 inches stroke.

There is a steam engine 4 inches diameter by 4 inches stroke for operating the machine-shop tools, such as lathe, drill press, emery grinder, etc.

The windlass engine has two steam cylinders, each 7 inches in diameter by 8 inches stroke.

There will also be a 10-Kw. dynamo driven by a 7 by 7-inch engine.

To show to what an extent the use of auxiliaries has reached in a modern steam vessel, it may be interesting to note that the combined volumes of the steam cylinders of all auxiliaries on this vessel amount to 70 per cent. of the volume of the high-pressure cylinder of the main engine.

TRIAL TRIP.

The under-way trial took place in the lower part of Chesapeake bay and Hampton roads on February 6, 1904, and consisted of a total run of eight hours at varying speeds and under varying conditions, such as the vessel is expected to encounter under service conditions. On the first four hours of the trial, under natural draft, using all four boilers, an average speed was developed of 14.92 knots, which was determined by observations in passing between light houses and measuring the distances from charts. Runs in both directions were made in order to neutralize, so far as possible, the tidal influences. The following are the approximate results obtained as an average of the performance of the main engine during the natural-draft trial:

I. H. P. main engine	1601.4
Revolutions	133.3
Steam pressure (at engine)	145 lbs.
Vacuum	26.5 inches
First receiver	41 pounds
Second receiver	5 1-2 pounds
Strokes of air pump	65
Revolutions of circulating pump	268
Strokes of feed pump	20
Temperature of sea water	50 degrees
Temperature of discharge water	74 degrees
Temperature of hot well	89 degrees
Temperature of feed water	166 degrees

During the latter part of the forced-draft trial, an opportunity was offered of testing the speed under maximum conditions in comparatively deep water, between Old Point Comfort and Thimble Shoal light. The distance is 3.3 nautical miles, and two runs were made over the course in each direction, without slowing the engine at the turns, at an average speed of 16.82 knots. Shortly before these trials were begun one of the blowers became disabled, so that it was impossible to carry an air pressure of more than 1-4 inch in the fire room, whereas 3-4 inch had been maintained during the earlier part of the trial. The fires were also quite dirty; with an air pressure of 3-4 inch and clean fires the vessel could undoubtedly make a maximum speed of 18 knots per hour. The following data were recorded as a result of the maximum run under forced draft, the by-passes being opened to the first and second receivers at the time the cards were taken:

I. H. P. (main engine only)	2,604
I. H. P. all auxiliaries (estimated)	156
I. H. P., total for main engine and auxiliaries	2,760
Revolutions	154

MARINE ENGINEERING DATA CARD. JULY, 1904.

NAME—Mohawk. NATIONALITY—American. TYPE—Revenue cutter.
LAUNCHED—1902 BUILDERS—Wm. R. Trigg Co. OWNERS—U. S. Treasury Department.

Length over all	205 ft. 6 ins.
" between perps	188 " 0 "
Breadth, molded	32 " 0 "
Depth, "	17 " 0 "
Draft, mean, normal	11 " 0 "
Displacement, corresponding	985 tons
Area immersed midship section	299 sq. ft.
Wetted surface	6,722 " "
Block coefficient	.486
Midship section coefficient	.799
Engines: Type	3 cylinder triple
Cylinder diameters	25, 37 1-2 and 56 1-4 ins.
Stroke	30 "
Valves, piston on H. P., slide on I. P. and L. P.	
Columns, front, forged steel, back cast iron	
Piston rods, diameter	5 ins.
Connecting rods, diameter,	
top 5 ins., bottom 6 1-2 ins.	
" length bet. centers, 6 ft. 3 "	
Crossheads, ahead surface	208 sq. "
" pins, 5 3-4 ins dia. by 6 1-4 ins. long	
Crank pins, 10 1-2 ins. dia. by 13 1-2 ins. long	
Shaft, crank, and propeller, diam., 10 1-2 ins.	
" thrust and line, " 9 3-4 "	
Thrust surface (9 collars)	575 sq. ins.
Air pump	independent twin vertical
Condenser, cooling surface	2,870 sq. ft.
Boilers	4 Scotch
Steam pressure	160 lbs.
Length over all	10 ft. 1 ins.
Diameter, outside	11 " 8 "
Thickness of shell	1 1-8 "
Furnaces	2 each, 41 ins. diam. inside
Length of grate	6 ft.
Tubes, outside diam	2 3-4 ins.
Number 58 stay, 164 ordinary,	
Length between sheets	6 ft 11 1-2 "
Height of stack above grates	54 ft. 6 "
Draft, forced closed stoke hold.	
H. S. one boiler	1 357 sq. ft.
G. S. "	43.8 " "
Area through tubes, calorimeter	6.04 " "
" of smoke stack	30 6 " "
H. S. ÷ G. S.	31
G. S. ÷ Calorimeter	7.24
Propeller:	
Diameter	10 ft. 9 ins.
Pitch (true)	13 " 6 "
Area (helicoidal)	40.43 sq. ft.
Material	cast steel
Number of blades	4

Slip, actual, mean of four runs	17.5 per cent.
Steam pressure	160 pounds
Vacuum	27 inches
First receiver	62 pounds
Second receiver	15 pounds
Strokes of air pumps	58
Revolutions of circulating pump	270
Strokes, feed pump	33
Temperature, sea water	50 degrees
Temperature, discharge water	86 degrees
Temperature, feed water	185 degrees

The steam machinery of the *Mohawk* was designed and superintended by Captain John W. Collins, the engineer-in-chief of the revenue cutter service, and it represents in its entirety as complete and efficient an installation of marine devices as was ever put in a vessel of this size and class.

and poop decks are covered by boat decks extending out to the ship's side, thus providing sheltered promenades for both first and third class passengers. A somewhat novel feature in the vessel is the special stowage arranged for yeast, a perishable cargo, of which considerable quantities are carried by this route.

The decorative features of the public apartments have been very carefully designed and executed. The first-class deck saloon is framed in oak, the panels, frieze, and dado being richly figured teak, giving a most effective contrast. The apartment is lighted overhead by fine skylight with richly colored stained glass, while round the air trunk there is a series of borrowed lights in lead work and art glass. The upholstery is in crimson buffalo hide. The windows are draped with gold tapestry curtains, while the floor is covered with Wilton carpet and runners. The dining saloon is framed

THE LATEST TURBINE STEAMER, PRINCESS MAUD, BUILT FOR THE IRISH CHANNEL ROUTE.

New Turbine Steamer Princess Maud.

The steamer *Princess Maud,* which has just been launched at Dumbarton, by Wm. Denny & Brothers, for the Larne & Stranbaer Steamship Joint Committee, is the first turbine steamer to be placed on the Irish cross-channel service. Her principal dimensions are, length 300 feet, breadth 40 feet, depth 24 feet 8 inches to promenade deck.

The first-class accommodation, which is situated amidships, consists of a deck saloon, ladies' cabin, smoking room, and four special state-rooms on the promenade deck, a dining saloon and a number of special state-rooms on the main deck. The third-class accommodation aft consists of a ladies' cabin on the poop deck, a saloon on the lower deck, and a large restaurant on the main deck, alongside of which is accommodation for cattle dealers. The remaining spaces on the main and lower decks, together with the fore hold, are fitted up for the carriage of cattle and horses. Both the bridge and paneled in oak throughout, dim polished, enriched by judicious arrangement of carving. The architectural style is Renaissance in character. There are neat little sideboards at the fore end of the saloon flanking the mast casing, which are surmounted by beveled mirrors, a clock and barometer in carved cases being fitted above the mirrors. A similar sideboard is fitted in a recess at the after end of the saloon, balanced by a hot press, which externally is of cabinet work similar to the sideboards. The upholstery is in crimson buffalo hide and the windows are draped with tapestry curtains in blue and gold, the floor being covered with Brussels carpet and runners. Entrance to the saloon is obtained by two sets of swinging doors with fine leaded glass panels, into which are wrought the "bloody hand of Ulster." Above the centre of the saloon is a large well for light and air, finished in white and surmounted by a skylight having stained glass of appropriate design and coloring. The ladies' saloon on the

promenade deck is in ivory white with polished cedar dado; the upper part is an arch design with Greek ornament, freely treated. There are large, full height mirrors and leaded glass doors. The seats are upholstered in figured moquette of blue shades; the windows have gold tapestry curtains and the floor is laid with Wilton carpets and runners. The ladies' retiring room on the main deck is in polished sycamore, the panels being decorated in Japanese style with apple blossom and bird design. A well-fitted-up dressing table, with large mirror above, is fitted for the conveniece of the lady passengers and the apple blossom "motif" is repeated in the leaded glass door. This apartment is upholstered in blue, figured moquette. The smoking room is paneled throughout in dim polished oak, lightly relieved with carving. As in the other apartments, full advantage is made of the decorative effect produced by richly colored stained glass, both in the skylight and in the entrance doors. A special decorative feature of this apartment is a set of three large enameled tile panels, beautifully colored, representing marine subjects, conventionally treated. The seats are upholstered in crimson buffalo hide, and the usual smoking room requisites are fully supplied.

The vessel is fitted with a complete galley, pantry, etc., and the lavatory accommodation is thoroughly up-to-date, baths being provided for both ladies and gentlemen. The ship is lighted throughout by electric light, the installation being carried out by the builders themselves. The appliances for working the ship are of the most complete description, consisting of a powerful steam windlass and capstan on the forecastle, and a large warping capstan on the poop. To facilitate handling in harbors the vessel has rudders both aft and forward, the after rudder, which is of the balanced type, specially designed by the builders for their turbine steamers, is worked by Brown Brothers' steam tiller, controlled from the flying bridge by telemotor. The forward rudder is worked by a steam steering gear, also controlled from the flying bridge. The vessel has an equipment of boats and other life-saving appliances, fully up to Board of Trade standard, all the boats being fitted with rapidly clearing chocks and patent disengaging gear. The propelling machinery consists of three sets of turbines by Parsons Marine Steam Turbine Company, supplied with steam by boilers constructed by Messrs. Denny & Company, of Dumbarton. On official trial the guaranteed speed of 20 knots was exceeded, the mean speed of 20.7 knots being attained.

Turbines and the British Board of Trade Survey.

A decision relating to the construction of turbine steamers was lately issued by the Court of Survey in Glasgow on an appeal by William Denny & Brothers, the shipbuilders, of Dumbarton. The facts briefly set out are as follows: The *Princess Maud,* built by Denny & Brothers, is a turbine ship. The turbine engines are provided by Messrs. Parsons and built by them at their own works. What they built and supplied to Denny & Brothers stopped at the condensers; that is to say, the propelling power was provided by Messrs. Parsons from their own works, and no questions arose with regard to it. The turbines were delivered to Denny & Brothers, and had to be fitted to the vessel, and the minor parts of the machinery provided by Denny & Brothers and attached by themselves included the condensers required for the turbines. The question between the Board of Trade and Denny & Brothers had reference to the condensers and to their sufficiency for what was required of them.

The Messrs. Denny took up the position that the Board of Trade were not entitled nor justified in demanding a certain test before the condensers were passed with a view to the certificate which was necessary for a passenger vessel. The certificate is issued by the Board of Trade, but as a precedent there was required to be made a declaration by the shipwrights' surveyor and the engineers' surveyor who had the vessel under survey. The Board of Trade had given certain instructions to their surveyor with which he was required to comply, but the Messrs. Denny refused the necessary facilities, and the certificate accordingly was refused. The question which the Court had to try was whether headquarters had the right to give its surveyors such directions, and whether those were competent and reasonable. The question arose because they were dealing not with ordinary engines, but with turbine machinery, experience of which had not been yet sufficient to enable the Board of Trade to lay down the same simple series of regulations as with regard to the engines to which shipbuilders had been accustomed for many years.

The Court sustained the appeal, and pointed out that this test is a new departure in survey practice, and that, as the Board of Trade was the party proposing to depart from use and wont, it lay upon them to show that there were new circumstances justifying a new departure. Considerable importance attached to this point, as it was admitted that if the Board of Trade's action was approved, this requirement would become a precedent for turbine steamer surveys in future, and would place turbine steamers at a disadvantage compared with ordinary steamers. The Court, however, find that the test is unreasonable. They point out that, while the Board of Trade have a great duty to the traveling public, they also have a responsibility to the shipbuilding and allied industries, and must not in their zeal for the public safety unnecessarily impose restrictions on an industry, and especially an industry in its development stage.—*Iron Age.*

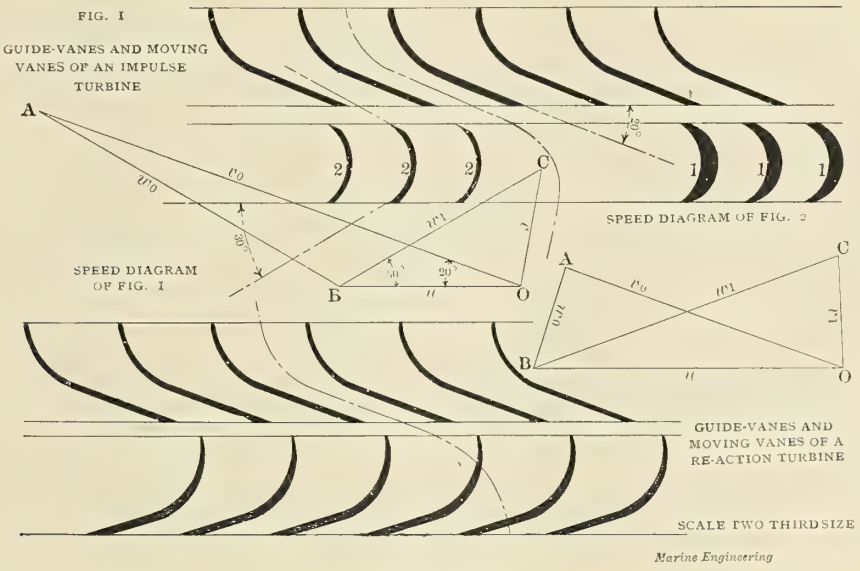
One Shipyard to Continue.—Creditors of the Townsend-Downey Shipbuilding Company, at a recent meeting, unanimously adopted a resolution requesting receiver Henry S. Ide to obtain authority to continue the business for an additional eight months from the time of expiration of the present extension on July 1. The opportunities for bidding on new work and for carrying out repair work are so favorable that the creditors made this request.

DIFFERENT APPLICATIONS OF STEAM TURBINES.*

BY PROFESSOR A. RATEAU, OF PARIS.

One of the most interesting developments in mechanical engineering during the years 1902 and 1903, was the greatly extended use of steam turbines. This development is the result of efforts which have been made by various people to increase the efficiency of turbines to such a point that they may compete commercially with reciprocating engines. The author has been occupied for more than fifteen years in the study of rotary engines, and he has already published several papers upon the subject. He believes that in presenting to the Institution of Mechanical Engineers an account of the practical result of his labors upon steam turbines he will contribute usefully to the study of this important question.

Although the principles which distinguish the different kinds of turbines are well known, it may be useful to recall briefly their distinctive characters in order that his own type of turbine may be more easily distinguished. In common with all other steam engines, turbines transform into mechanical work the energy given out by steam during its expansion from the initial pressure of admission to the pressure at the exhaust. But whilst reciprocating engines effect this transformation of energy by means of variation in pressure of the steam, turbines can effect this transformation both by means of the pressure and by means of the velocity of the steam while expanding. The employment of the velocity only in each moving wheel characterizes the action or impulsion turbines, among which may be cited the Laval and Curtis turbines, as well as that designed by the author; whilst the simultaneous employment of the velocity, and partial use of the pressure characterize the re-action turbine, of which the best-known type is that of Parsons. Whatever may be the method in which the steam acts in the turbine, the chief problem consists in the employment, with good conditions of efficiency, of the very great velocities attained by the steam in expanding. When the expansion takes place in one stage, as in turbines with a single wheel, then the velocity of flow reaches, as is well known in a condensing engine, a value which is usually above 3,600 feet per second. But in order to obtain the maximum efficiency, the moving part of the machine should have a relative velocity which is approximately the half of that of the steam. As it is practically impossible to construct turbine wheels suitable for running with a peripheral velocity above 1,200 feet per second, the efficiency of turbines with a single wheel is necessarily low, this being due chiefly to the necessity for the employment of diverging inlet nozzles which give rise to great losses of energy by friction and eddying. On the other hand, angular velocities which correspond to these peripheral speeds prevent the direct driving of dynamos, and render necessary reduction gears of special and costly construction, which, however, cannot be protected from excessive wear, and are exposed to accidental breakage.



FIGS. 1 AND 2.

A consideration of these circumstances has induced inventors to divide the expansion of the steam into successive stages, and thus to produce turbines with multiple wheels, which are nothing but a series of simple turbines mounted upon the same shaft and driven successively by the same current of steam. This design of multiple turbines is by no means novel. It will suffice to mention the name of Tournaire, a French mining engineer, whose theoretical description to the Academy of Science in 1853 of a re-action turbine with multiple wheels is surprising, when the description is compared with the Parsons turbine brought into use 30 years later.

Every simple turbine may be designed either as an impulse turbine or as a re-action turbine. In the former kind the fall of pressure under which the simple turbine works takes place solely in the distributor, whilst

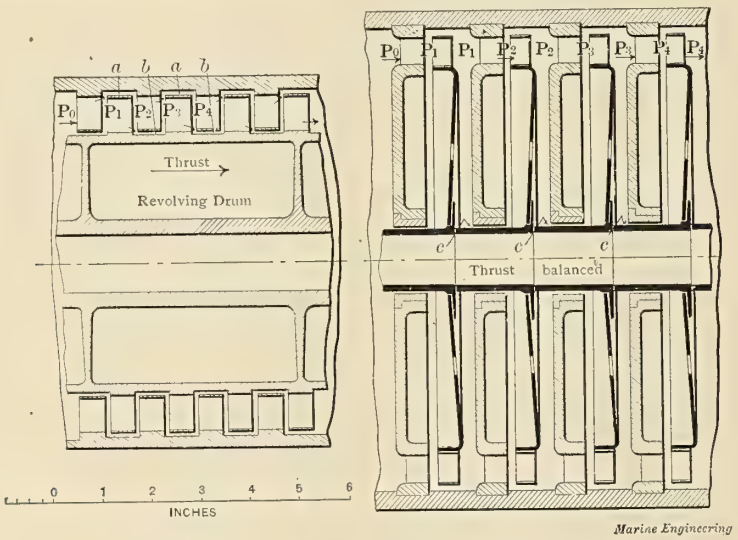
*Paper read at the Chicago meeting, June, 1904, of the Institution of Mechanical Engineers of England.

in the latter type the fall of pressure takes place, not only in the distributor, but also in the moving wheel, so that in the latter type there is a higher pressure in the guide vanes than at the exit. Fig. 1 represents the guide vanes and the moving vanes of an impulse turbine, in which it is supposed that the fall of pressure is small enough at the vanes to render unnecessary the use of diverging nozzles, as in the Laval turbine. In the illustration the triangles of velocities are given at the entrance *OAB*, and at the exit *OBC* of the moving wheel. Similarly in Fig. 2 are shown the guide vanes and the moving vanes of a re-action turbine, and the triangles of velocities at the entrance *OAB* and at the exit *OBC* of the moving wheel are shown in the figure. It is obvious from these illustrations that, by the mere inspection of the moving vanes, it is possible to distinguish between an action turbine and a re-action turbine. In the former type the vanes appear in transverse section in the form of an arc of a circle with entrance and outlet angles practically the same, whilst in the re-action turbine the cross section of the vanes is in the form of a parabolic arc, the entrance angle being more or less approximately 90 degrees, whilst the outlet angle is generally between 20 degrees and 30 degrees. Generally the vanes are increased in thickness in the middle, so that the steam spaces between them have approximately a constant transverse section for impulse turbines or decreasing section for re-action turbines. If, however, they are made of plate they may have a constant thickness, as in *2*, Fig. 1. In re-action turbines it is important that the increase in thickness should be suitably calculated, otherwise there will be an important loss of efficiency. It is otherwise with the impulse turbine, in which the efficiency is very little affected whether the vanes have a constant or variable thickness. In a given turbine with multiple wheels the different simple turbines may be all designed in the same way or some may be designed in one way and some in another way to produce a hybrid system.

Drum Turbines and Multicellular Turbines.—From another point of view, drum turbines may be distinguished from multicellular turbines; in the former type, of which the Parsons turbine is the best-known example, the moving vanes are fixed upon the periphery of a cylindrical drum; in the latter they are fixed to the periphery of wheels more or less flat and separated from each other by diaphragms which divide the interior of the turbine into cells. The turbine of the author belongs to the latter type.

Fig. 3 is a diagram of a drum turbine, and Fig. 4 a diagram of a multicellular turbine. These two types have different properties, so far as losses of steam are concerned. In the multicellular action turbine leakage of steam can only take place through the play *c*, Fig. 4, which exists between the shaft and the ring of the fixed diaphragm which surrounds this shaft. In the re-action drum turbine, on the contrary, leakage may take place: first, around the moving wheels in *a*, Fig. 3 (by reason of the re-action); and second, in *b*, through the play between the guide vanes and the moving drum. The first leakage can be suppressed, if desired, by making the wheels work by impulsion instead of by re-action, but then the second leakage between the fixed vanes and the moving wheel attains its maximum. It is because of this leakage at the periphery of the drum that turbines of the Parsons type require the most accurate workmanship. It is easy to understand that a play of some tenths of a millimeter is sufficient, at least upon the high-pressure side, to produce a cross-sectional area of the leakage passages equal to that of the admission passages between the distributing vanes; if by specially exact workmanship the cross section of the leakage passages is made very small, is it not to be feared that, after some years of use, the wear of the parts, either by friction of the moving parts against the fixed parts or by the action of the steam, will increase the cross section of the leakage passages, and so cause a notable decrease in the efficiency of the machine?

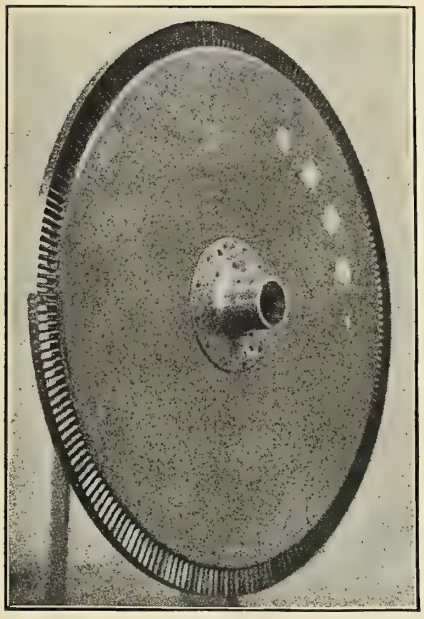
In multicellular turbines the leakage, being confined to the periphery of the shaft, is reduced in proportion to

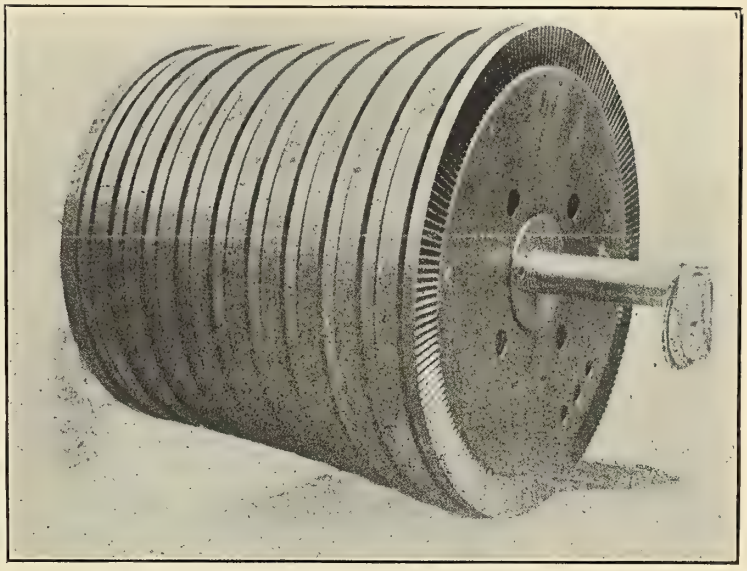


FIGS. 3 AND 4.

the radii of the shaft and the drum; and, moreover, friction being less to be feared at a place where the relative velocities are smaller, the play may be reduced to the absolute minimum. In practice we do not trouble about giving this play any precise value. We build the machine with practically no play round the shaft, and when started the machine itself makes play sufficient to turn without touching the internal rings of the diaphragms.

Friction of the Moving Parts on the Steam.—It would appear probable that multicellular turbines produce relatively large losses by friction of the moving parts upon the steam owing to the large surface of the moving wheels. This is, however, not the case. From tests which we have made to determine the law of friction, and also from the results of experiments made upon complete machines, we have found that frictional losses represent only from 2 to 4 per cent. of the normal power developed by the machine. These figures apply to turbines with an output exceeding 500 horse power. These figures are comparable with those obtained in drum turbines in which the friction of the moving vanes themselves must be added to that of the cylindrical surface of the drum.





FIGS. 5 AND 6.

Turbines with Groups of Wheels.—Another type of turbine which may really be considered as belonging to the impulse class is being built upon a large scale, and is known under the name of Curtis. In this type instead of using upon a single moving wheel the velocity of discharge of the steam leaving the distributor, it is used upon several wheels arranged in series in order to diminish the velocity gradually. The principle upon which the Curtis turbine is designed has been described, in 1890, by Mr. Mortier, in a discussion which took place after a paper had been read by the author upon steam turbines in general and upon the Parsons turbine in particular.*

*See Comptes Rendus de la Société de l'Industrie Minerale à St. Etienne. Meeting of April 12, 1890.

The type which we have described as having a group of wheels possesses the notable advantage of allowing a great reduction in the speed of rotation for wheels of the same diameter and of the same number. It would, therefore, be preferred to all others if it had not, in our opinion, the grave defect of preventing a sufficiently high efficiency being attained. It is easy to see that, owing to the great velocity of flow of the steam in the first wheels, the losses of energy by friction and eddying are very great, reaching such a value that the second wheel develops less power than the first, and the third wheel less power than the fourth, when more than two are used, and they act more like brakes than prime movers. The Curtis turbine, as originally constructed at the Fisk station in Chicago, had groups of four wheels, but the process of evolution reduced these to groups of three, and then to groups of two wheels. Even with such a reduction in the number of wheels in a group the efficiency, according to our calculation, is still at least 20 per cent. lower than that obtainable with the multicellular turbine which has only one wheel per cell. The author therefore ventures to think that the Curtis type of turbine will disappear, as in the process of evolution it will become the multicellular type pure and simple.

Description of the Rateau Turbine.—Since 1894, the firm of Sautter-Harlé, of Paris, with the assistance of the author, has been experimenting upon the construction of steam turbines. The first turbine constructed had only a single moving wheel, like the Laval turbines, and this wheel was formed with vanes in the form of a double arc, similar to the buckets of a Pelton wheel, and these vanes were milled out of a solid block of steel. This type has since been copied in the Riedler-Stumpf type, built by the Allgemeine Elektricitäts Gesellschaft, but which was rapidly abandoned, as it did not offer any chance of obtaining the maximum efficiency. The most recent Rateau turbine is of the action type; that is to say, expansion of the steam is fully carried out in the

distributor for each group consisting of a distributor and one moving wheel. The steam, therefore, acts by its velocity and not by its pressure. These turbines are, moreover, multicellular; that is to say, they consist of a certain number of elements, each element comprising one distributor and one moving wheel. A very interesting characteristic of the type of action turbines is the possibility which it allows of leaving very considerable play between the fixed parts and the moving parts, and this greatly facilitates construction and obviates the chances of dangerous friction if the bearings should become worn or the shaft somewhat bent. Besides this, the wheels revolve in a chamber where the pressure is uniform. There is, for that reason, an absence of longitudinal thrust upon the moving parts and no necessity for the use of dash pots for the purpose of overcoming the effect of this thrust, although such dash pots are necessary in re-action or drum turbines. Finally, in the action type partial injection of steam is possible; that is to say, the steam may be directed upon a limited portion of the circumference. The moving wheels are formed of discs of sheet steel more or less thin, and upon the periphery of these discs are riveted vanes of cylindrical form, Figs. 5 and 6. A steel band riveted to the periphery maintains the correct spacing of these vanes and insures great rigidity to the construction. Wheels so constructed are extremely light, and remain in equilibrium at a velocity far higher than that to which they are subject in the turbine. These moving wheels turn between circular diaphragms provided with distributing vanes which enter circumferentially into grooves formed in the interior of the turbine case. Between two adjoining diaphragms is therefore produced a cell or very flat chamber in which the moving wheel revolves. The shaft passes through the diaphragm in collars of anti-friction metal with very slight friction. In the first diaphragm which the steam passes through the distributing vanes are placed only upon a part of the circumference. Partial injection of the steam is therefore obtained, and thus the velocity of the steam is better utilized. Moreover, to produce the same effect the useful part of each distributor is set with an angular advance on the preceding section; this angle of advance is calculated according to the speed of rotation, so that the steam leaving one moving wheel enters into the following distributor and never encounters a solid wall which would produce a shock and therefore a loss of kinetic energy. For the last wheels it is necessary to employ total injection; that is to say, the distributing vanes must be set upon the whole circumference of the diaphragm, and, moreover, owing to the expansion of the steam, the radius must be increased. The bearings of these turbines are external, and by means of a special system of spring packing they are kept perfectly tight. No oil is carried by the exhaust steam to the condenser, and this has an important advantage, as the water of condensation can be used for feeding steam boilers direct without any necessity for the use of an oil separator. The speed of rotation is controlled by a centrifugal governor with a Denis compensator, which acts upon an obturator which controls the pressure of steam entering the turbine.

Mixed Turbines.—In the case of installations where exhaust steam must be used, a subject which we shall consider in detail at a later stage, it is often desirable to supply the turbines temporarily with steam at high pressure when the primary machine is stopped or is furnishing less steam, and the work done by the turbine must remain the same. In order to obtain economical working it is preferable not to expand this steam in order to lower it to the pressure for which the low-pressure turbine is built. Therefore, the author has designed a turbine which may be described as of the mixed type, and this can be supplied either simultaneously or separately by steam at high pressure and by steam at low pressure without any lowering of the efficiency of the mechanism. In order to attain this result the turbine is constructed in two parts, one designed for high-pressure steam and the other for low-pressure steam. The steam at high pressure having done work in the first portion will pass to the second portion, which may be fed either by steam coming from the accumulator or by the exhaust from the first portion. The admission of high-pressure steam into the first portion is automatically obtained by means of a special regulator which allows steam from the boilers to pass to the first portion as soon as the pressure in the accumulator falls below a given value. This arrangement, which has been adopted in all the new applications of the system to the use of exhaust steam, works very economically, and is particularly suitable to cases in which the primary machine works irregularly, and where, therefore, the demand for live steam is frequent and somewhat prolonged. In the small machines the two portions are usually joined together.

Efficiency of Turbines.—It is essential that the word efficiency should be clearly defined in order to avoid any misconception as to the figures which are given below. The author uses the expression "Theoretical consumption of the perfect machine" to denote the maximum work which the steam is capable of supplying when starting from the saturated or superheated condition in which this steam is delivered to the engine and expanding adiabatically with no loss of admission pressure P to exhaust pressure p. By comparing the actual consumption of steam as measured during the tests of the machine with this theoretical consumption of the perfect machine for identical conditions of pressure and similar states of the steam, the net efficiency of the machine is obtained. After special study of the question, the author has been able to draw a curve of theoretical consumption and to derive from it the following empirical formula for use when the steam is saturated and dry at admission:

$$K = 0.85 + \frac{6.95 - 0.92 \log P}{\log P - \log p}.$$

This formula gives the consumption K in kilograms per horse-power hour of 75 kilogrammeters as a function of the absolute pressures P and p expressed in kilograms per square centimeter. In British measures this formula becomes:

$$K = 2.13 + \frac{16.20 - 2.05 \log P}{\log P - \log p}.$$

K in pounds per horse-power hour, P and p in pounds per square inch. The curve which is given in Fig. 7 will readily afford interesting information, particularly if it be necessary to estimate the consumption of steam

with a given machine to obtain a certain useful effect. In that case the theoretical consumption per horse-power hour given by the curve should be compared to the exact consumption of steam actually observed with the machine, and of course referring to the particular number of electrical horse power developed by the dynamo driven, or to the power in water raised (expressed in horse-power hours), if pumps are driven by the machine. The relation between these two figures of consumption gives the combined efficiency of the group, and therefore takes account of all the losses of the steam engine and of the driven mechanism. This combined efficiency is merely the product of the efficiency of the prime mover multiplied by the efficiency of the machine driven. If the steam admitted to the turbines is superheated, then, of course, in estimating the theoretical consumption the extra calorific energy corresponding to the superheat must be taken into account;* but for the exact estimation of this extra energy we have not as yet adequate precise knowledge of the specific heat of the vapor of water. At present we have merely the figure obtained by Regnault after very cursory experiments (0.48), a figure which is merely a rough approximation.

The author has begun some experiments upon this subject from which he believes he will be able to prove that the true specific heat of steam is not constant, as has been usually supposed up to the present. It varies inversely as the amount of superheat, and is probably approximately unity for very small values of superheat, and approaches 0.40 for large amounts of superheat.

Calculation of the Efficiency of Turbines.—The efficiency of a turbine may be calculated *à priori* when a preliminary study has been made of the practical coefficients which must be introduced into the theoretical formula. We calculate this efficiency with quite a remarkable degree of accuracy by dividing the losses of the machine under two headings: first, the internal losses which are produced by friction and eddying of the steam in the fixed and moving vanes; second, the external losses which correspond to the leakages of steam in the play between the fixed and moving parts; and to the friction of the wheels upon the steam and to the friction of the bearings. The first kind of losses give rise to the *internal efficiency,* which may therefore be called the "hydraulic efficiency" by extending the use of the term employed for hydraulic turbines. This internal efficiency depends upon the more or less perfect form of the vanes, and also to the relation between the peripheral speed of the moving vanes and the speed of flow of the steam. It is possible to draw a curve showing the efficiency as a function of the peripheral velocity, and therefore it is easy to at once assign the degree of efficiency which a given turbine will realize.

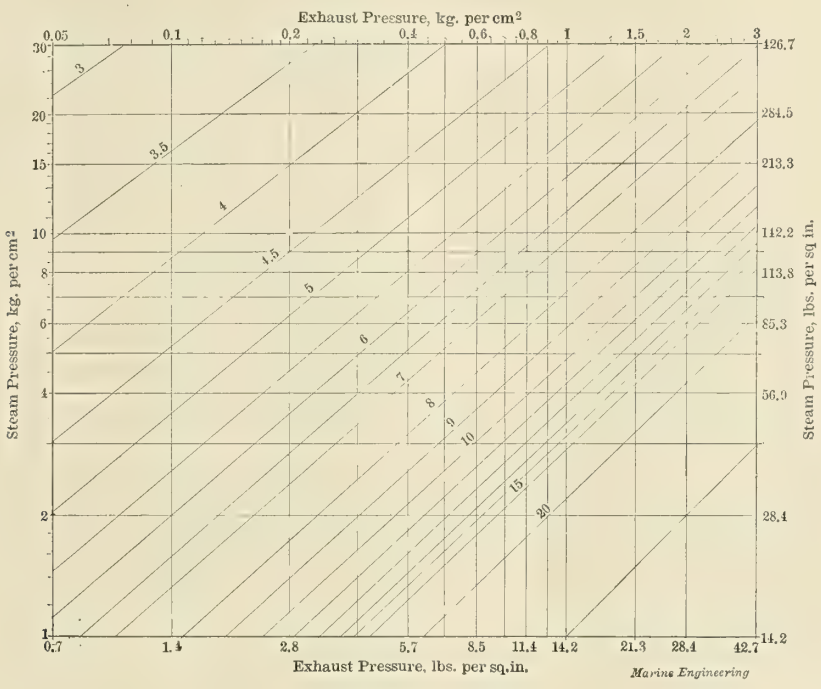


FIG. 7.

Once having fixed the internal efficiency, then, in order to obtain the net efficiency, we must deduct the losses by leakage as well as the losses by friction of the wheels upon the steam, and also those in the bearings. Let us take, for example, a multicellular turbine of 1,500 brake horse power upon the shaft with a speed of 1,500 revolutions per minute. By means of practical coefficients found by experience we can calculate that the internal efficiency of such a machine may easily rise to 69 per cent.; on the other hand, the losses by leakage and by friction in the bearings absorb 1.5 per cent. of the normal power, and the losses due to friction of the wheels upon the steam amount to 2.5 per cent., making a total for the external losses of 4 per cent. The net

*These results were published for the first time in the "Annales des Mines de Paris," in February, 1897, and since that date have, on many occasions, been republished in various French and foreign publications.

efficiency upon the shaft at the speed stated will then be .69 multiplied by .96 = .66. From this value of efficiency it is easy to calculate the consumption of steam per horse-power hour which would be required by this turbine under conditions of pressure and of superheat of the steam already determined. All calculations for designs of turbines that we have made by this means have always proved correct within 1 to 2 per cent. of actual practice. Such accurate calculations are not possible in the case of reciprocating engines owing to the action of the cylinder walls, which makes calculations uncertain and often inaccurate, whilst in the turbine the continuity of flow of the steam allows practical calculations of a high degree of accuracy to be based upon theory once having determined the fundamental coefficients which are employed in the formulæ. For a more detailed consideration of the use of these coefficients the author refers to the work which he published in 1903 in the *Revue de Mécanique,* entitled "Théorie élémentaire des Turbines à Vapeur."

The Results of Actual Practice.—The author began the construction of his first multicellular turbines in the year 1898 in collaboration with the firm of Messrs. Sautter-Harlé, of Paris, and there are now already at work, or in process of manufacture, turbines developing more than 25,000 horse power in units varying from 10 to 2,000 horse power, irrespective of the designs now in preparation. Some of these turbines are used for driving dynamos, others for pumps, for fans, and for the propulsion of vessels.

The author concludes with a brief abstract of the conditions and economical results of the most interesting of these installations. The applicability of turbines for driving fans is also pointed out. A field for the application of turbines for the utilization of exhaust steam from non-condensing intermittently-operated reciprocating engines is discussed at some length. For this purpose a steam accumulator consisting of a vessel containing solid and liquid materials is used, which he calls a fly wheel for heat. This system, if successful, would make it feasible for the utilization of considerable power which now goes to waste. The author's paper on "Steam Turbine Propulsion for Marine Purposes" was given in Marine Engineering for June, 1904.

Propellers Turning Outboard.—The engines of all future British naval ships, according to London *Marine Engineer,* are to be so designed that the screw propellers will turn outwards for driving the vessel ahead. For some time the practice has been to fit the engines to turn the screws inwards, but experience has shown that this causes a loss in manœuvering qualities, and also in propulsive efficiency, especially where the propellers work close to the hull of the ship. A London correspondent of the *Glasgow Herald* has pointed out that experiments in Italy confirmed this view, which is entertained by many officers in the service. In the French Navy experiments have been made with the same result, and, as a consequence, it has been decided that all small cruisers and torpedo craft shall be fitted with outturning screws. The Admiralty, however, has made the change operative on all ships. One of the advantages of the in-turning screw was that the engineer's platform could be in the center of the ship, so that he had full control and view of both engines. In the merchant service this advantage is got even with outturning screws, but to obtain this result it is necessary to have heavy columns or frames in the front of the engines, so as to take up the thrust of the cross-head and connecting rod. Not only would extra weight be involved in this change—an important consideration in warships—but the view of the engine would be restricted. In naval machinery round forged-steel columns are now used in all cases, and the engineer in charge can see all parts at a glance, and can ascertain easily if any part of the machinery shows a tendency to heat. In the new cruisers the starting platform will be in the wings of the ship, the back columns of the cast-iron form with slipper guides for the thrust of the crossheads and connecting-rod being placed next to the longitudinal bulkhead which separates the two engine-rooms.

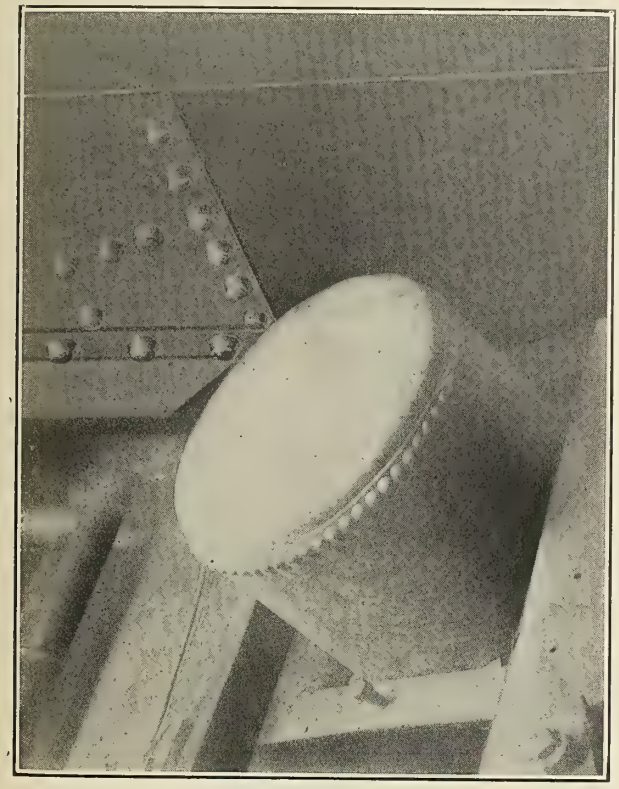
Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of June 13, 1904, the following degree of completion of vessels building for the United States Navy:

			Degree of Completion. Per Cent.	
BATTLESHIPS.			May 1.	June 1
Ohio	18 knots.	Union Iron Works	93	94.5
Virginia	19 "	Newport News Co	59.4	61.2
Nebraska	19 "	Moran Brothers Co.	46.9	49
Georgia	19 "	Bath Iron Works	52	54.13
New Jersey	19 "	Fore River S. and E. Co	57.6	58 7
Rhode Island	19 "	Fore River S. and E. Co.	59.8	60.7
Connecticut	18 "	Navy Yard, New York, N Y.	38.46	42.1
Louisiana	18 "	Newport News Co.	47.91	49.31
Vermont	18 "	Fore River S. and E. Co.	6.8	8.9
Kansas	18 "	New York Shipbuilding Co.	7.5	9.6
Minnesota	18 "	Newport News Co	26.15	29.59
Mississippi	17 "	Wm. Cramp and Sons	2.3	3.5
Idaho	17 "	Wm. Cramp and Sons	2.2	3.2
ARMORED CRUISERS.				
Pennsylvania	22 knots.	William Cramp and Sons	76.9	80.5
West Virginia	22 "	Newport News Co.	83.4	85.49
California	22 "	Union Iron Works	60	60.5
Colorado	22 "	William Cramp and Sons	80.9	84.9
Maryland	22 "	Newport News Co.	78.88	82.8
South Dakota	22 "	Union Iron Works	55.5	57.5
Tennessee	22 "	William Cramp and Sons	28.9	34 4
Washington	22 "	New York S. B. Co.	24.2	29.3
PROTECTED CRUISERS.				
Denver	17 knots.	Neafie and Levy	99.9	100
Des Moines	16½ "	Fore River S. and E. Co.	....	....
Chattanooga	16½ "	Lewis Nixon	80.01	84.23
Galveston	16½ "	Wm. R. Trigg Co	78	81
St. Louis	22 "	Neafie and Levy Co.	41.2	42.6
Milwaukee	22 "	Union Iron Works	48	50.5
Charleston	22 "	Newport News Co.	69.7	73.1
GUNBOATS.				
Dubuque	12 knots	Gas Engine and Power Co.	40	42.6
Paducah	12 "	Gas Engine and Power Co.	33.6	35.7
TRAINING SHIPS.				
Cumberland	Sails	Navy Yard, Boston	35	42
Intrepid	"	Navy Yard, Mare Island	16	23.3
TRAINING BRIG.				
Boxer	Sails	Navy Yard, Portsmouth	34	42
TORPEDO BOATS.				
Stringham	30 knots.	Harlan and Hollingsworth	93	96
Goldsborough	30 "	Wolff and Zwicker	99	99
Blakely	26 "	George Lawley and Son	99	99
Nicholson	26 "	Lewis Nixon	99	99
O'Brien	26 "	Lewis Nixon	98	98

Submarine Bell Signaling.

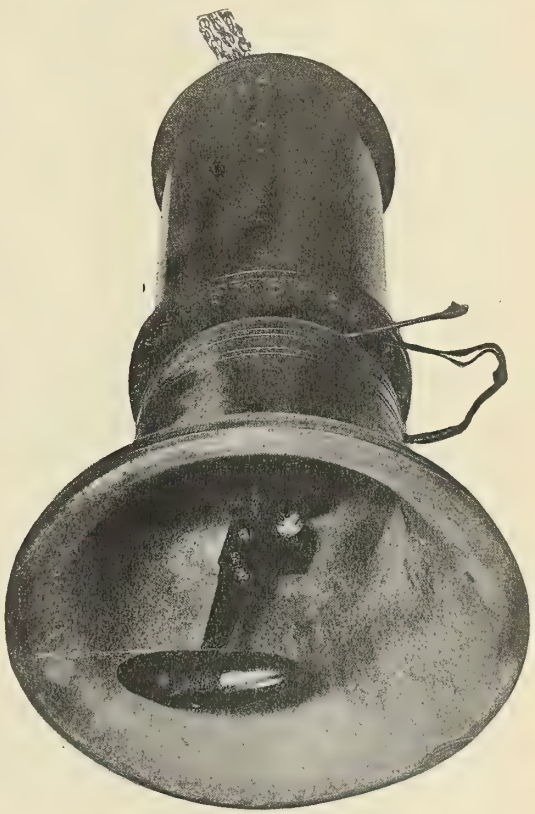
Recent tests have proved conclusively that the system of submarine signaling by means of sound with water as a medium is an assured success, and this remarkable achievement marks an era of distinct progress in the science of navigation. For more than two years repeated experiments have been made toward the accomplishment of this end, for, notwithstanding the improvements incident upon the use of steam power in battling against the elements, the great menace to navigation arising from the snows, fogs, and high winds of winter and spring has heretofore remained practically unalleviated.



CYLINDER IN WHICH RECEIVING MECHANISM FOR SUBMARINE BELL SIGNALS IS PLACED.

It is easily seen that signaling by means of lights and fog whistles is fraught with uncertainty and disadvantage, the success of thus warning ships of danger depending entirely upon atmospheric conditions. A driving snow may preclude the possibility of seeing the lights, and the roar of the tempest may with equal certainty destroy the sound waves of a whistle before they could reach the mariner. Since the atmosphere is so unstable it would seem that to water alone, which is virtually unchangeable, and which as a conductor of sound has four times the power of air, must we look for a solution of the problem, giving us a means of signaling that will be equally efficient in foul weather as well as fair.

Working upon this theory, Mr. Elisha Gray began the invention of a mechanism that would collect and transmit the sound through water. But this inventor died when his efforts were only in an experimental stage, and others have succeeded him with the investigations. As a result, an organization known as the Submarine Signal Company was finally formed, which through many experiments developed the apparatus, until to-day the efficient transmutation of sound through water for uses of navigation has been accomplished. The chief feature of the apparatus consists of two magnetic transmitters peculiarly sensitive to sound, which are in cases in two small cylindrical iron tanks, open and flanged at one end. One of these tanks is shown on this page. These tanks are placed one on the starboard and one on the port side of the ship, below the water line, close to the stem, a hole is cut in the shell, and over this the flanged end is riveted. These transmitters receive the sound waves, and wires convey the electric impulses to the pilot house, where an apparatus similar to the usual telephone receiver makes it possible for the captain to hear the sounds in the water within several miles of his ship. There is a switchboard in connection with the telephone by means of which it is possible to tell from which side of the vessel the sound proceeds. If, by moving the switch to starboard, the sound becomes diminished, it is known that the source of the sound waves is on the port side, and *vice versa*. If, however, the sound may be heard with equal distinctness from both port and starboard sides of the ship, it is inferred that the bell or other object producing the sound is head-on. And, so delicate and accurate is the apparatus that the direction may be determined within a quarter of a point of the compass.

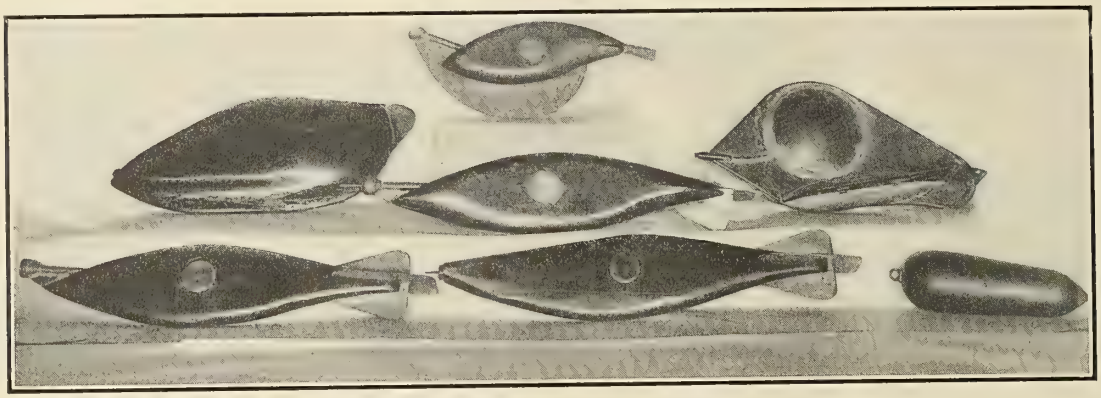


1,000-POUND ELECTRIC BELL FOR SUBMARINE SIGNALS.

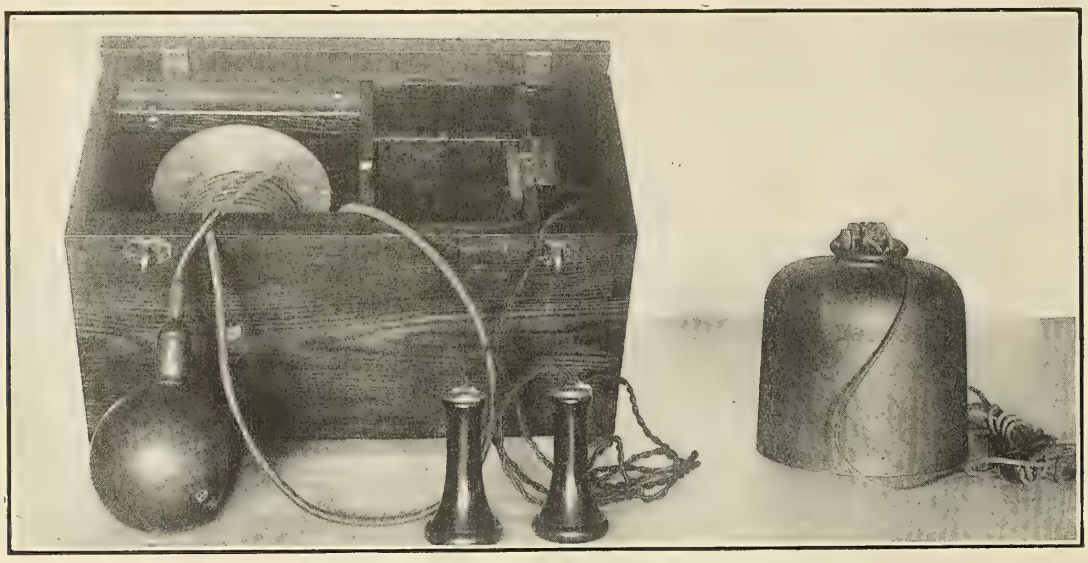
To further facilitate the use of these instruments, there is a sort of speaking-tube attachment reaching from the receiver to the fore part of the pilot house, so that the captain, by making the connections, may receive the sound messages without leaving the wheel.

To use the signaling invention necessitates the equipment of lighthouses with bells of special manufacture. These bells, sometimes of 1,000 pounds' weight, wrung by electric power ,are placed at a distance of 25 feet or more below the surface of the water, and their constant peals, heard by passing ships that are provided with the signal apparatus, may be conveyed at present a distance of six or seven miles. A second valuable application of the service is suggested by the exchange of signals between ships in time of war, and still farther could the utility be carried in locating the position of vessels by listening for the sound of the screw, the equipment of both vessels with apparatus not being a necessary condition.

For small fishing smacks and other craft not fitted up with the usual conveniences of the pilot house, a modification of the apparatus just described is made, which has the advantage of being portable. A large wooden chest, capable of being moved to any desired position on the vessel, holds this useful apparatus—the battery, telephone receivers, and coils of electric wires, at the end of which are attached the fish receivers. These latter appliances, corresponding to the stationary tank-enclosed transmitters on the two sides of the ship, are thrown overboard to a depth of from 15 to 50 feet, and are so constructed that they register the sound vibrations as do the fixed receivers. But, although supplying a certain need to these small sailing vessels, they are less satisfactory than the larger mechanism, since accident to the submerged wires may detach the fish receivers, whence they would be lost at sea. Vessels using this movable signaling service are also supplied with dory bells, by means of which they may signal to passing craft.



FISH RECEIVERS FOR SUBMARINE BELL SIGNAL OUTFIT.



BALL RECEIVER AND DORY BELL FOR SUBMARINE SIGNALING.

For several months the four steamers of the Metropolitan line have been equipped with the apparatus of the larger type, and tests were made on the *James S. Whitney,* on a trip from New York to Boston, when Canadian and American government officials, naval

officers, and others were present. Signals were satisfactorily transmitted between the ship and the temporary apparatus placed on the Vineyard sound lightship and Boston light. The ringing of the 650-pound bell, sunk 25 feet below the lightship, was heard five miles away.

On this same trip the ringing of the bell in the fore peak of the *H. M. Whitney,* en route to New York from

RECEIVING DEVICE, MOVING THE SWITCH TO DETERMINE WHETHER THE SOUND COMES FROM STARBOARD OR PORT SIDE.

Boston, was detected when the ships were within an estimated distance of three miles of each other.

These demonstrations of the usefulness of this new contrivance for the prevention of accident at sea, places it upon a sure footing, and ranks the submarine bell-signaling service as a boon to ocean and coastwise traffic.

New Staten Island Ferryboats.

The Maryland Steel Company, Sparrow's Point, Md., has been awarded the construction of the five steel screw-propelling ferryboats for the Staten Island ferry service by the city of New York. The plans and specifications are drawn by consulting naval architects Millard and MacLean of New York city. The boats were built for the Department of Docks and Ferries, Maurice Featherson, commissioner. The bids were opened in the commissioner's office, June 17, from eight shipbuilding firms, and were so close that they reflected credit both on the manner in which the specifications were drawn and the care with which the bids were prepared.

There were two classes of bids, Class X calling for the installation of Babcock & Wilcox or Niclausse boilers, and Class Y, which calls for Mosher, Hoehenstein, or Seabury boilers. The bids were received as follows, the first amount being for one boat, and the succeeding amounts for each additional boat:

Class X: Harlan & Hollingsworth, $362,000, $341,00, and $331,500; Bath Iron Works, $355,900 and $347,900; Burlee Dry-Dock Company, $345,000 and $341,000; H. F. Palmer, $352,000 and $347,000; Eastern Shipbuilding Company, $350,000 and $345,000; W. & A. Fletcher Company, $365,000 and $346,300; Wm. Cramp & Son Ship and Engine Building Company, $350,000 and $340,000; and Maryland Steel Company, $365,500, $349,200, $341,200, $341,700, $327,600, and $325,000.

Class Y: Harlan & Hollingsworth, $341,000, $320,000, and $312,000; Bath Iron Works, $340,100 and $332,100; Burlee Dry-Dock Company, $335,000 and $329,000; H. F. Palmer, $338,000 and $333,000; Eastern Shipbuilding Company, $335,245 and $326,245; W. & A. Fletcher, $365,000 and $346,300; Wm. Cramp & Son Ship and Engine Building Company, $340,000 and $330,000; and Maryland Steel Company, $351,500, $337,000, $331,200, $319,000 and $317,000.

The contract awarded to the Maryland Steel Company was for Class X, and amounts to $1,709,000.

All the vessels are to be delivered in one year from date of signing contract. The general dimensions are: length over guards, 250 feet; length to outside of stern posts, 247 feet; length to outside of propeller posts, 218 feet; breadth of hull molded at deck, 46 feet; breadth over guards, 66 feet; depth, molded, 19 feet 6 inches; draft to bottom of keel, 12 feet; freeboard, 7 feet 6 inches.

The boats are of the double-deck type with large cabin on upper deck. The hull is of steel throughout. The center house will be of steel and between the wagon ways and the cabins will be longitudinal steel bulkheads.

Each boat will have two inverted, direct-connecting, 2-cylinder compound-surface condensing engines, each set with cylinders 22 1-2 by 50 inches diameter by 30 inches stroke. The two sets of engines are to be coupled together at the crank shafts. There will be two boiler rooms, one at each end of the engine room, and the grate surface of the boilers shall be not less than 340 square feet, and the heating surface not less than 125,000 square feet; the working pressure is to be 225 pounds per square inch. Forced draft on the closed stoke-hold system is to be provided. Each boat is to be electric-lighted throughout with 475 incandescent lamps, the current to be supplied by two direct-connected generating sets 25 Kw. each.

The cabins are to be heated by the hot-air system, fresh air being taken from outside, heated over coils and delivered at the top of the cabins.

Full particulars and plans of these boats will be given in succeeding issues of Marine Engineering.

Submarines for Japan.—Considerable interest was aroused in the mysterious movements of the steamer *Fortuna* off the Atlantic coast recently. She sailed presumably for Japan, and has on board one of the Lake torpedo boats. The president of the submarine company has left for the Orient.

Turbine Yacht.—The third English-built turbine yacht to be enrolled in the American yacht clubs, is the *Lorena,* which recently arrived in New York bay. She is of the large cruising type, designed by Watson, and is owned by Mr. A. L. Barber.

Marine Engineering

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE most appalling calamity that has in many ways ever been recorded, occurred, as all of our readers are aware, on June 15, when the excursion steamer *General Slocum* took fire, burned to the water's edge, and sank at the entrance of Long Island sound. The horror of this accident, in which over nine hundred helpless women and children perished from fire or drowning, is most appalling. Many heart-rending cases, in which whole families were destroyed, have thrown the city and country into deep grief. The daily papers have given full details of the accident and accompanying scenes. Nothing can be done for those who have been lost, and but little assistance may be rendered to the survivors in their deep grief regardless of the amount of subscription which is now being raised for the destitute. All that can be done is to investigate into the causes which brought about such fearful destruction, to place the responsibility, and to pass such laws covering the construction and inspection of such vessels as will prevent a repetition of the catastrophe. At the time of writing, the most plausible reason advanced as to how and where the fire broke out is that it occurred in the lamp and paint room in the forward hold. When it was discovered the fire hose was connected up and the fire pumps started, but all to little avail, as the fire was already raging, and the mate is quoted as stating that the hose gave way in a dozen places. Gaining headway instantly, the fire enveloped the boat in smoke and flames, and the feeble efforts of the fire fighters amounted to naught. At the time of writing investigations are under way by Federal and city authorities, and it looks as if the loss of life were much greater than should have been if the life-saving apparatus had been in good condition. It is stated the life preservers were filled with powdered cork and the canvas covers were rotten.

The reasons of the captain's determination to run his vessel aground at North Brother island, fully fifteen minutes beyond the nearest shoal water, and at a time when every minute meant dozens of lives, does not as yet appear clear. At this crisis his judgment alone had to be depended upon. At every foot of the way the flames which broke out forward were carried back by the head wind, dealing death and destruction on all sides. Whether or not the captain's decision was right is a matter of opinion, but the unflinching way in which he and his two pilots stuck to their posts until after the boat had grounded, while the very pilot house was burned away from them, shows the true heroism of the men, and, in fact, the only bright spots in this fearful scene are those of sacrifice, bravery, and heroism shown by some of the rescuers.

Concerning the responsibility for this accident, it should first be stated that the *Slocum* was duly inspected on May 7, of this year, by United States steamboat inspectors and certified to be in good condition to carry 2,500 passengers, to be fully equipped with life-saving devices, and to comply with all regulations of the laws. Who, then, is to blame for the catastrophe, and what is to prevent a similar one happening to dozens of other excursion steamers built and equipped in a manner similar to that of the *General Slocum?* As the steam craft of our harbors are under the supervision of government officials, the public has the right to infer that such vessels are reasonably safe to travel on, otherwise what value is the government guarantee? It is impossible for each passenger to make an examination into the fire equipment, the soundness and the stability of every vessel he takes passage on, or that he engage an expert to make such inspection for him. The vessel's

certificate of inspection, granted by the government, is for just such purpose. The obsolete, inefficient, and insufficient rules governing the inspection of steamboats has been a subject of continual appeal to Congress. These rules, which were laid down many years ago, have long since outlived their usefulness, and only deal with present construction through innumeral disconnected amendments and revisions. In the last session of Congress a bill was introduced to improve the steamboat inspection service, but although it passed the Senate and was an administration measure it was held up in the House. Sad it is to comment that all measures of relief seem only to be secured after some horrible calamity. The inertia of indifference, or carelessness of officials of the government or of private corporations, or, in fact, the individual, can only be overcome by a fearful lesson.

That the *Slocum* disaster may not be repeated, it is primarily essential that a fundamental change be made in the construction of these vessels. Such an accident on board an ocean-going steamer, built of steel and subdivided with steel bulkheads, would be impossible. In an excursion or river steamer, where all the passengers are accommodated in wooden deck houses or on decks built entirely of wood, whether or not the hull were of steel would make little difference. It appears then that the necessary constructive changes should be made such that the upper works be built of steel, asbestos, or other fire-proof construction, and that light metal bulkheads subdivide the deck space. One means of protection suggested is that asbestos curtains, or asbestos bulkheads hinged on the beams to swing down in place be so placed as to suitably subdivide the deck space. Also, very efficient and complete fire-fighting apparatus is absolutely essential. In our theatres, where the public congregate in great numbers, the law is very rigid regarding the fire-proof construction and fire protection. Members of the fire and police departments are always in attendance to prevent panic and direct in putting out the fire.

It is now positively asserted that the crew had never been trained in the fire drill or in launching the boats. In fact, it is stated, that it was impossible to launch the life boats. So far the evidence in the examinations of witnesses and conditions tends to indicate criminal negligence on the part of the steamboat company and inefficiency on the part of the steamboat inspection service. While the horrors and loss of life of the accident might have been lessened, it is evident that the laws governing the construction and inspection of vessels must be changed before immunity of such disasters in the future may be reasonably expected.

At the sessions held in New York, Philadelphia, Baltimore, and Boston, of the American Merchant Marine Commission, appointed to investigate the condition of the present state of the American shipping and shipbuilding, and to report to the next Congress, testimony advocating about every conceivable system was given. The commission has an arduous task before it. In the first place, the bill creating this body is considered but a shrewd political move to put off till after the next election any congressional action on this subject. Congress has repeatedly attempted to enact some form of shipping subsidy, but as yet no policy has been formulated which will be acceptable, and the responsibility for such a policy has now been laid upon the shoulders of this commission. It is almost useless to hope that the entire commission may unite on one policy, as it is composed of members of both parties, and hence there is almost sure to be a minority report, however the tales of distress of present conditions, given at the hearings, are sure to impress each member, whether Democrat or Republican, that something must be done, and that speedily, or the American flag will be obliterated from the ocean.

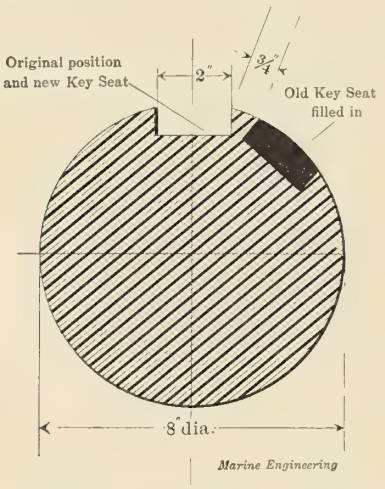
The testimony given at New York was, generally speaking, lamentably weak and diversified. Advocates of mail subsidies, differential duties, bounties on exports, subsidies on cargo vessels, bounties to the shipbuilder, each presented his case for alleviating present conditions. Several shipbuilders testified of the very great increase in cost of American-built ships. The testimony in Philadelphia, Baltimore, and Boston, was practically a reiteration of the opinions expressed in New York. Taking it all together, the preponderance of evidence seems to be in favor of either mail subsidies to regular steam lines to distant markets, or preferential or discrimating duties in the indirect trade. While it is hoped that the commission may be able to formulate some plan generally acceptable, the testimony so far taken does not give assurance that this will be the case.

Queer Damage to Rudder Stock.

Editor Marine Engineering:

Possibly some of your readers will be interested in a peculiar accident which came under my notice some time ago, and before the Dominion government had erected the plant for lighting the Welland canal. One of the large wooden steamers running between Ogdensburg and the upper lake ports was coming down this canal from Lake Erie on a very dark night. On account of the slow speed, the vessel lost steering way, and the stern swung round and drove the rudder into the hard clay bank.

When freed it was found that the steering gear was deranged, making it necessary to tie up till daylight. By means of cables the steamer was warped to the town of Welland, where there is a machine shop. The chief engineer came over to the shop and asked for a man, a couple of sets of chain blocks, and a small set of sheer legs we happened to have handy, to help him to unship



SECTION SHOWING TWIST IN RUDDER STOCK, AS RESULT OF ACCIDENT.

the rudder stock. The rudder and stock were coupled together by means of a large flange coupling. The stock was 8 inches diameter, about 9 feet long.

The main bearing for the rudder was at the deck above, and about 12 inches below the bearing was keyed the tub of the quadrant, the key seat being about 18 inches long.

The shaft and quadrant were brought to the shop where careful examination showed nothing wrong with the quadrant, but on looking at the shaft the key seat was found to be twisted into a long spiral. However, not a sign of crack or flaw could be detected in the shaft, not even an appreciable bend, so the chief ordered us to fill up the old key seat, cut a new one, key on the arm, and re-erect as soon as possible.

The accompanying figure shows a section of the shaft with dimensions of the change made, it being understood there was not the slightest displacement at the coupling end. In fact, the new key seat was laid off from the position of the coupling. The old key seat was filled up as solid as possible, the surface being turned off in the lathe. Repairs were complete late in the evening and the steamer proceded on her trip. Unfortunately, I have no dimensions of the steering quadrant arm whereby an idea of the force exerted could be calculated, but it must have been very great.

Robert Logan Hamilton.

A Marine Experience.

The following is taken from a communication to *Power* by an engineer named Thomas Grieve.

"Some years ago I was appointed to take charge as chief engineer in a steamer which was then bound from Liverpool to Baltimore, by the way of Genoa, Italy. I was advised by the superintendent of the line that the ship was nine months old, and that as far as the engines were concerned, they were a failure. The builders of the engines had had their men running them, but with very indifferent success. I was required to go there and find out the cause of the abnormal consumption of coal, the slow speed, etc. As the steamer was nearly ready for sea, there was no time for overhauling. However, I picked my own men. We started out, and the engines handled fairly well getting out of the docks, but we found we had caught a Tartar by the time we got to be fairly under way. The engines were of the vertical compound type, with cylinders 34 and 64 inches, with 39-inch stroke, fitted with double eccentrics and Stephenson link motion on each engine, steam reversing gear and surface-condensing. There was a very heavy pound on the crank centers of both engines, and the main journals were overheating quite frequently. We could not get any more than 18 to 20 inches of vacuum, and, although we had good coal, the steam was very hard to keep up to our working pressure of 90 pounds. After being two days out and having good weather, I tried the indicator and found practically a good card, only a slight lack of compression; but the admission and expansion lines were good. The want of steam led me to believe that we were carrying steam too far on the stroke, but cutting off shorter by the link motion only made the pounding on crank pins worse.

"In the meantime some one had found in the store room a set of laths or wood tempates marked off to show the ports on the cylinder face and valve. This was a lucky find. I got a piece of board and cut out a circle large enough to get a pin in at a point half the throw of the eccentric, which I found to be 8 1-8 inches. I drilled a hole in the center of this board and fastened it to the partition wall in a cool place, where I could do some thinking. After laying off half the throw on this board I made a wooden eccentric rod and fastened the lath of valve face to it. Fastening the lath of cylinder face securely to partition, I traversed the lath of valve over lath of cylinder face, noting at each position of the valve in what position the piston in the cylinder was, which was found by taking the ratios of stroke of the piston and valve. I assumed that the valve must have about 1-8-inch lead, and from that standpoint I found the cut-off for steam, and likewise the operation of the exhaust ports. By the way, the valves were the gridiron, double-ported valves. After deliberation I increased the lead to 1-4 inch, and found that the steam would be cut off 2 1-2 inches on the stroke earlier. The exhaust I concluded would take care of itself until further developments.

By this move the board showed that all the eccentrics would have to be advanced 1-2 inch on the shaft. However, I eventually decided to try this alteration. When we arrived at our first stopping place, all hands were put to work. The eccentrics, I think, were 30 inches diameter, put in with keys, 3 inches wide by 1 inch, sunk in the shaft. We chipped out enough in the eccentric keyway to advance 1-2 inch and fitted in a temporary key alongside of the permanent one, making it secure by caulking over the end of the permanent key. As our time was very limited, we had not time to look at the valves, but I felt sure of my ground. After examining the pumps to find out what seemed to be the matter with our vacuum, we found everything in order; but after taking down the condenser ends, it struck me forcibly that the condenser was too full of tubes, which were 7-8-inch brass, with wooden ferrules to fasten in tube sheet. I drew out fifty of these tubes, starting wide at the top and tapering down to the center for five rows. After plugging these holes with wooden plugs we closed everything up, and were ready to get under way. The first few revolutions of the engine demonstrated that we had done the very thing that had been needed. The consumption of fuel went down, and we made a substantial gain in speed. The boilers showed ample steaming capacity, and we had no trouble in holding 26 inches of vacuum, due to the fact that the exhaust steam was distributed around the condenser and coming in contact with the cooling surfaces. I steamed about 7,500 miles in this steamer after this and had a very comfortable job. Needless to say that the engineering force received congratulations from the owners of the line when we arrived at our destination."

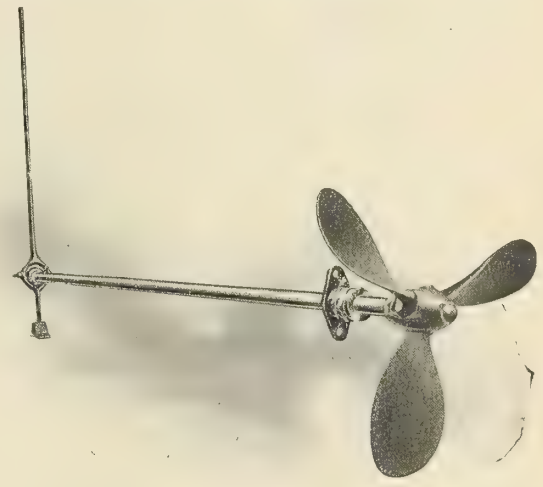
Contracts for Government Ships.—It is now expected at the Navy Department that contracts for the battleship and two armored cruisers, authorized by the last Congress, will be advertised early in September. The general plans of the battleship will closely follow those of the *Connecticut* class, both in displacement, over all dimension, armor and armament. The submerged torpedo tubes will be fitted. The engines are to be the usual 4-cylinder, triple-expansion type, aggregating 16,500 horse power, and it is probable that twelve Babcock & Wilcox boilers will be installed. The armored cruisers will be of 14,500 tons displacement, and practically identical to the *Washington* and *Tennessee*. The plans of the three high-speed scout vessels are not progressing so rapidly, and it is doubtful if contracts for these vessels will be advertised as early as September. The present machinery plans are for turbine propelling engines. The two colliers authorized, to be built in navy yards, to carry 5,000 tons of coal, and to have a speed of 16 knots, will probably not be commenced till after the next Congress has met. The appropriation for each vessel was $1,250,000, but no appropriation was made for equipping the navy yards wherein they should be built. As at present the only navy yard building slip equipped for such work is at Brooklyn, and there the slip is at present occupied by the battleship *Connecticut*, this work must of necessity be postponed.

ENGINEERING SPECIALTIES.

Reversible Propeller.

The annexed cut illustrates the Geyer reversible propeller, for which strong and simple construction and durability are claimed. It consists in brief of three parts: shaft, hub, and blades. According to design it is made in a two- or three-blade type.

The hub, or sleeve, has a certain amount of slip on the shaft and each blade is pivoted to the hub. Below



NEW TYPE OF REVERSIBLE PROPELLER.

each blade base and extending through the hub is a pin set into the shaft and this pin fits into a recess in the blade base. Shifting this sleeve backward or forward on the shaft by means of the lever will, as is evident, turn each blade about its pivot.

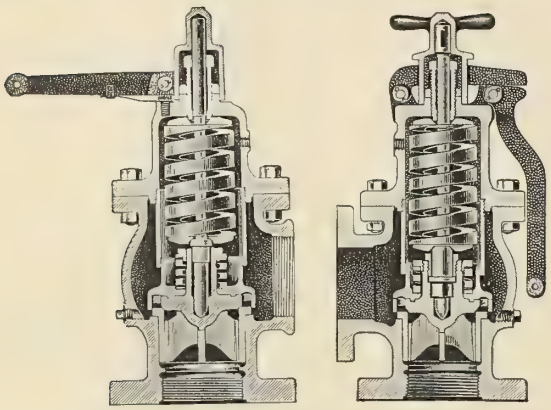
For further securing the blade the periphery of the blade base sets into a recess in the hub. The hubs, blades, and stuffing boxes are made of excellent quality of bronze, and all shafts are of tobin bronze, 6 feet long. W. E. Geyer, 373 Washington street, Boston, Mass., is the maker.

Pop Safety Valves.

The Crane Company of Chicago has brought out a number of improved forms of pop valves for stationary, marine, locomotive and portable boilers. The principal points of interest are shown in the accompanying illustrations of the pop valve and the marine valve. The chief point of interest of the pop valve is a self-adjusting feature, which automatically regulates the pop of the valve. In all pop valves it is necessary to have a pop or huddling chamber into which the steam expands when the main valve opens, thereby creating a valve-lifting force corresponding to this increased area, and greater than the force of the spring. Thus the valve is held open until the pressure is relieved. Means must also be provided to relieve this pop chamber of this pressure in order to allow the valve to close properly.

In this valve this is accomplished by a self-adjusting auxiliary valve and spring which are independent of the main valve and spring. The steam in pop chamber finds a passage through holes or ports into an annular space provided in the auxiliary valve or disk, and by reason

of the light auxiliary spring this pressure lifts the auxiliary valve and allows the steam in pop chamber to gradually escape, thus permitting a greater range in setting pressures with the least waste of steam, and, at the same time, supplying a cushion or balancing medium, thereby preventing any chattering or hammering and affording the easiest possible action in closing.



SECTIONS OF POP VALVES OF THE ORDINARY AND MARINE TYPES

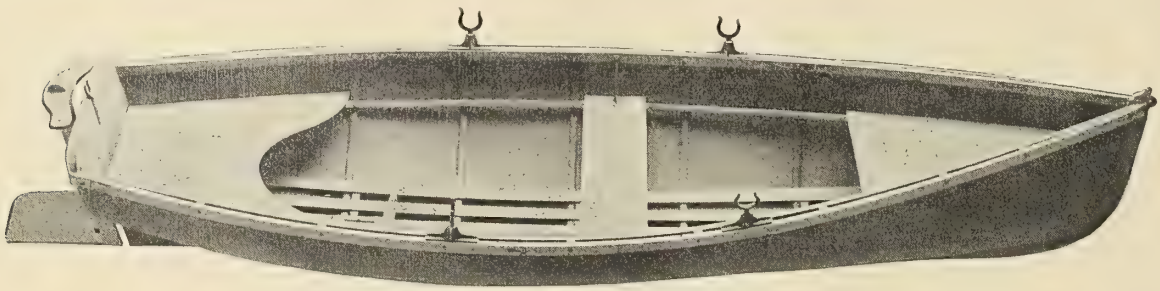
In some of the designs the chamber or casing incloses both springs, protecting them against the action of the steam, particularly high pressure, which, blowing with great force and velocity throughout all parts of valve before reaching the atmosphere, would otherwise have a tendency to disarrange the springs and other parts operating in connection therewith.

This form of valve is also particularly useful, in fact, necessary, where a number of valves may be connected to one main exhaust or discharge pipe. The encased spring chamber, extending over a greater portion of the top surface of the main valve, prevents any retarding action of the steam due to back pressure, which might be caused by one or more valves opening slightly in advance of another, in having any material effect on the free opening of the other valves.

The marine pop valve, which has been approved by the United States Board of Supervising Inspectors, has the same self-adjusting pop regulator as described above. The seats are beveled at an angle of 45 degrees from the center line of axis and are made of a composition of solid nickel bushing. The cam lever is capable of lifting off its seat on-eight the diameter of valve open, whether or not there is pressure on the boiler. The cam lever may also be thrown far enough over to lock the valve open should occasion require. The cap is made with handles and fastened to the stem by a key, and the stem in turn is securely attached to the main valve, and by turning the stem it is possible to turn the valve on its seat, thereby removing any incrustation that may accumulate. The springs are incased and made of best steel, with self-adjusting strong disks. The valves may also be taken apart without removal from boiler and without disturbing the outlet pipe. All parts have been so designed and proportioned that when fitted and adjusted with correspondingly strong springs the valves are suitable for pressures up to 250 pounds.

A Sheet Steel Yacht Tender.

The cut shows a thoroughly strong and seaworthy sheet steel yacht tender or dinghy, made by W. S. Mullins, 519 Depot street, Salem, Ohio. This is a very light and strong boat of fine model and is absolutely water tight. In either end air tanks are fitted which, in case the boat should capsize and be filled with water, will not only prevent it from sinking, but have sufficient buoyancy to keep above water several persons clinging to it. The boat has oak frames, to which are riveted sheet steel plates pressed to form. These plates are lap riveted and the joints soldered, making a very strong and water tight construction. The gunwale is strengthened with inside and outside wooden wearing pieces. The woodwork is of the best selected material, natural finish. Eyebolts are placed at the bow and stern for taking the davit block hooks. The smooth surface of the steel sides, fine model and light weight make this boat exceedingly easy to row, and the result of several years' experience proves it to be strong and durable.

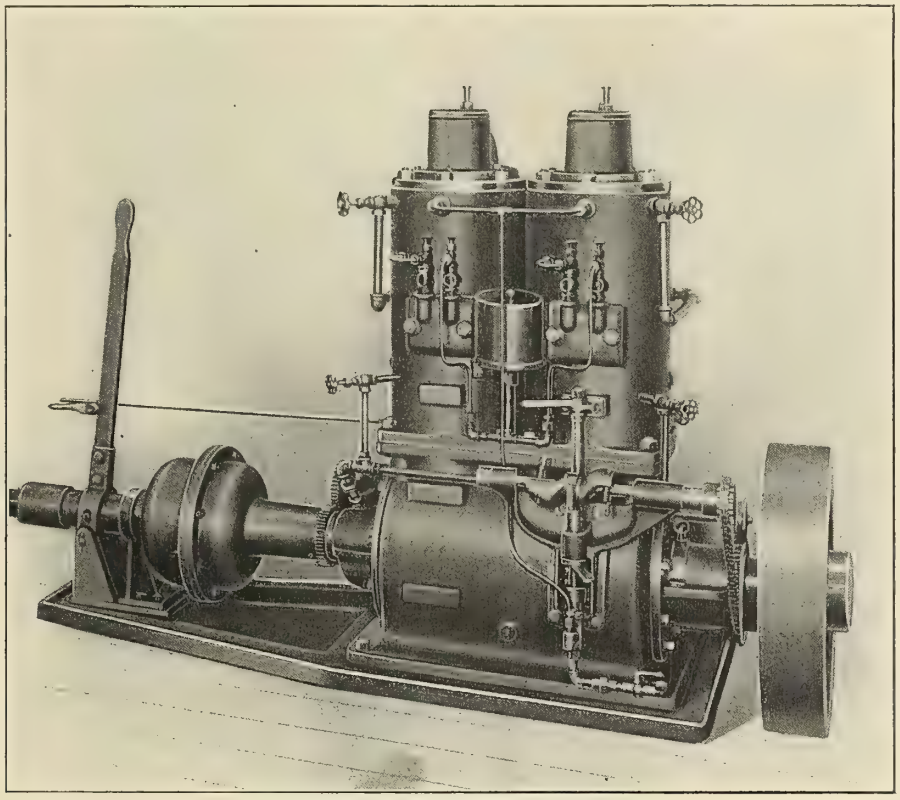


YACHT TENDER MADE OF SHEET STEEL.

Kerosene Marine Engine.

Practically all the oil explosive engines for marine purposes use gasoline fuel. There has, however, been brought out this season by A. Mietz, 128 Mott street, New York, N. Y., a marine type of kerosene engine, built along the same general designs of the stationary Meitz & Weiss kerosene engine, which has for so many years been in successful operation. The accompanying view is of the starboard side of a double cylinder, two cycle, 10-horse-power engine. The method of introducing the fuel is different than in other engines. By means of a small pump driven by a horizontal shaft geared to the main shaft, the kerosene is injected on hot plates at the top of the cylinder just about at the

end of compression. It immediately is vaporized, mixes with the air, and the explosive charge is pressed into a heated cast-iron sphere in communication with the top of the cylinder, which ignites the charge. The exhaust port is placed in the side of the cylinder, and the fresh air compressed in the crank case drives the spent gases



TWO-CYLINDER 10-HORSE-POWER KEROSENE ENGINE.

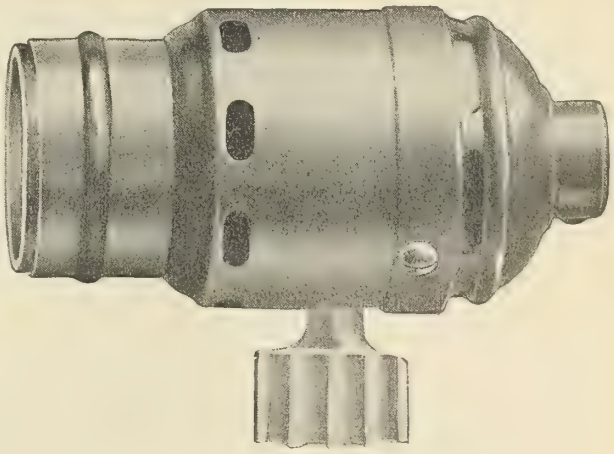
out of the cylinder. On the up-stroke, as soon as the cylinder has passed the exhaust port, the air is compressed and the cycle is repeated.

Regulation is secured on the pump shaft by an inertia governor, which changes the throw of the eccentric operating the kerosene pump. A small amount of water passes into the cylinder to clear out any crust or deposit from the gases. Lubrication is secured from a suction cup, shown between the cylinders. The cylinder walls are thoroughly water jacketed. For starting the engine a pilot flame is used to heat up the igniting sphere, as previously mentioned, but it is stated that after the engine is under way this flame may be extinguished as the sphere, which of course is not water jacketed, is kept hot by the exploding gases.

A special reversing clutch, shown at the left of the illustration, embodies many desirable features for which the makers claim high efficiency and minimum of wear.

Regulating Electric Socket.

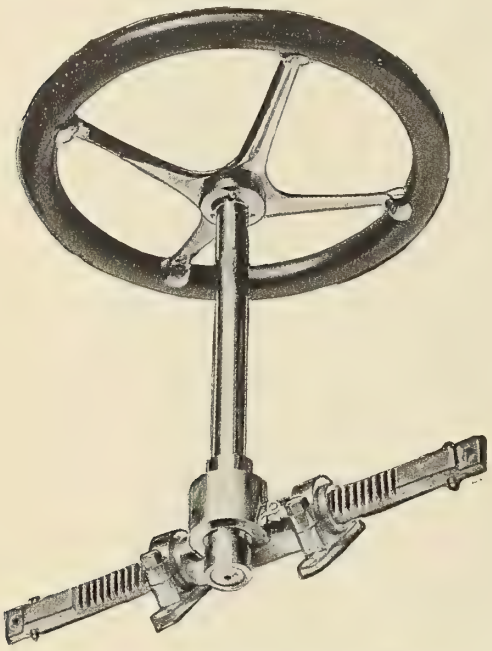
The Borgia regulating socket is an electrical fitting to be used for varying the amount of current delivered to a local circuit, such as a lamp, motor, or electrical heater. The device is inclosed in an outer shell resembling the ordinary incandescent lamp socket, in which is a receptacle containing local terminals fitted for connecting with the terminal plugs of the lamp or motor. The amount of current delivered to these plugs is regulated by a key, by interposing a varied amount of resistance medium. The key, which is similar to that of the ordinary socket, also serves to make and break the connection between the line and local circuit with



ELECTRIC SOCKET FOR REGULATING THE CURRENT.

a spring snap connection. Thus any degree of light may be secured from 1-2 candle power to the full candle power of the lamp attached by simply turning the

key. The socket fits any lamp or fixture, and may be used on a direct or alternating current. With the ordinary socket, of course, it is only possible to have a full light or no light, while with this, any degree of light may be attained and the corresponding amount of current used. As the expense of burning the light depends on the current, with the Borgia socket much saving may be made. This socket is made by William F. Stilz & Company, 720 Arcade Building, Philadelphia, Pa.



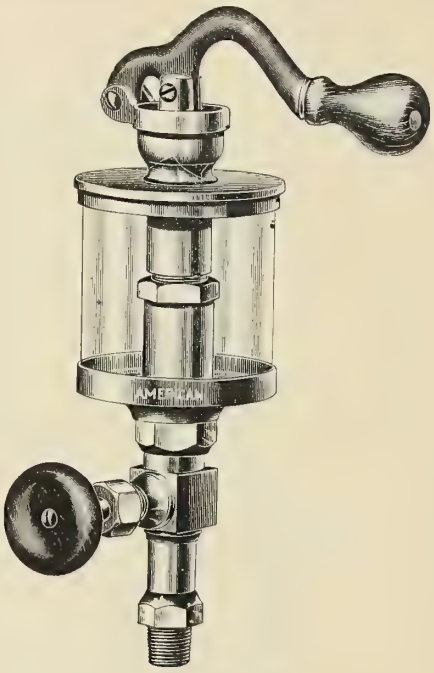
BRASS STEERING WHEEL FOR USE IN AUTO BOATS.

Auto Boat Steering Wheel.

With the advent of the auto boat many special fittings are required novel in boat equipment. Among these is a device for steering somewhat similar to the automobile. The hand-steering wheel made by Charles D. Durkee & Co., 2 and 3 South street, New York, N. Y., here illustrated, is a small, compact wheel which may be placed in the most convenient part of the boat, and may be set for any angle. It is designed for high-speed boats where quick manœuvering is absolutely essential. It has a rack and pinion motion which precludes any slip, bind, or play. All parts are of polished brass, except the wheel rim, which is of mahogany. The wheel is made in two sizes for boats up to 30 feet and boats up to 60 feet in length, while larger sizes are made to order.

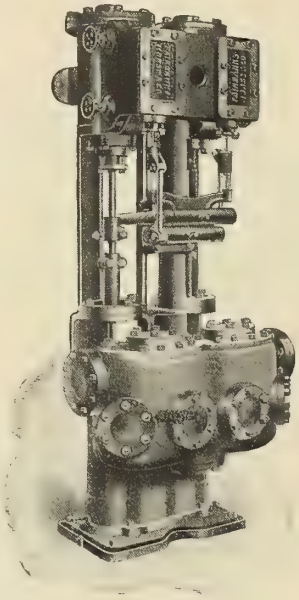
Glass Body Oil Pump.

As a guarantee against the cutting off of the oil supply to important bearings on different types of engines, it is becoming the practice to fit up an auxiliary oil pump. The "Ideal" pump, here illustrated, and made by the American Lubricator Company, Detroit, Mich., is built specially for this purpose. The pump is placed in the middle of the oil cup in line with the pipe connection, and is operated by a lever handle. It is easy to fill and operate, and the glass body shows the amount of oil present at all times. The construction of the pump is claimed to be first class in every respect, and each pump is thoroughly tested before leaving the factory.



HANDY OIL PUMP.

It is made in four sizes, the outside diameter of glasses of the smallest being 2 1-2 inches and of the largest size 4 1-4 inches.



VERTICAL DUPLEX MARINE BOILER FEED PUMP.

Duplex Marine Boiler Feed Pump.

The pump here illustrated is designed with a view of economizing floor space. It is very compact and yet all

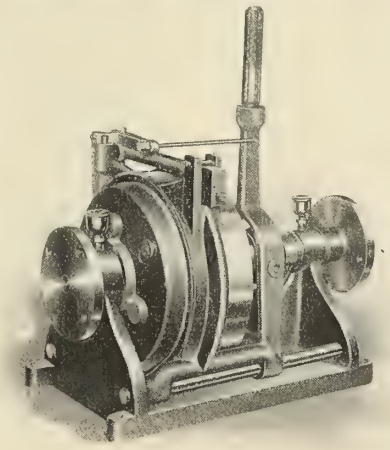
portions are easy of access when it becomes necessary to examine or repair them. The handholes, as shown in the illustration, permit the interior of the pump chambers being easily reached when new valves, springs, or guards are needed. One desirable feature is that the water pistons may be packed through the top of the water box without disturbing either the steam piston or any part of the valve motion.

The valve motion is of the interchangable design, the parts on one side of the pump being exact duplicates of like parts on the opposite side. This is a very desirable feature, requiring that a fewer number of spare parts be carried in stock than would be needed if the design provided for right and left parts, as is the case with many pumps. The steam cylinders are provided with cushion or dash relief valves to assist in securing an even stroke of the machine. The steam chests are in a single casting, bolted directly to the steam cylinder faces, thereby strengthening the steam end. The pumps are manufactured by the Fairbanks, Morse Company, Chicago, Ill., for any pressure up to 200 pounds per square inch.

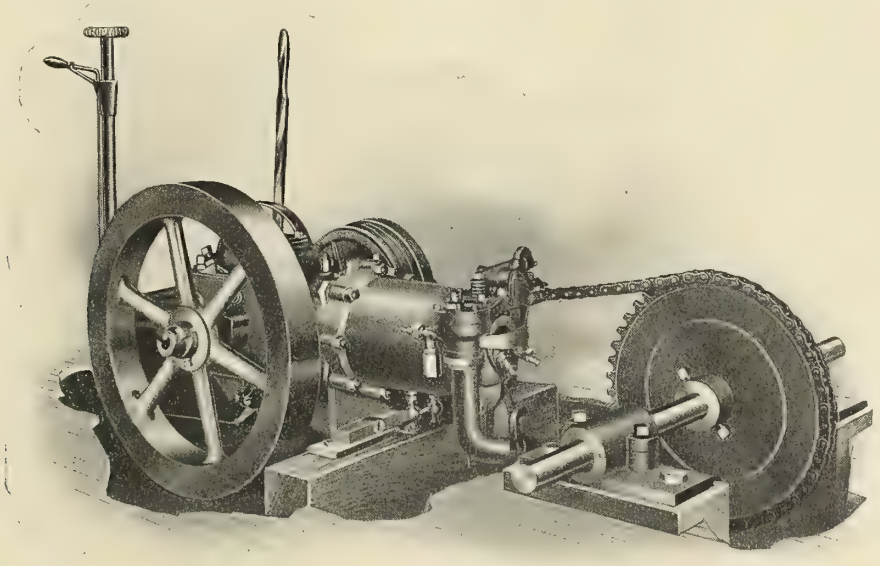
Engine for Paddle-Wheel Boats and Reversing Gear.

An engine here illustrated, brought out recently by the Chas. A. Strelinger Company, of Detroit, Mich., is designed for side or stern wheel boats. The size shown is suitable for boats from 25 to 35 feet in length, although on account of the small space the engine occupies it may be used for smaller vessels and yet by reason of its large power may equally apply to larger boats. In the South and Southwest stationary gasoline engines of the regular horizontal type have been used for driving small paddle wheel boats, but their introduction has been limited first on account of excessive weight, the 4 by 5 H. P sizes ranging from 1,200 to 1,500 pounds, and the 6 to 8 H. P. from 1,500 to 2,500 pounds or even more, and secondly by the rather elaborate system commonly used of clutches, cross belts and jack shaft, which, in many cases, take half or more of the deck space.

The engine shown here will develop 9 brake horse power, occupies less space than the ordinary 2-horse-power stationary engine, and weighs complete, as shown, less than 400 pounds, which permits its being placed at extreme end of stern if desirable. For side-wheelers the driven sprocket may be placed directly on the wheel shaft and driven from sprocket on the engine. In many cases this may be done with stern wheelers, or if for any reason it is deemed expedient or necessary, the paddle wheel may be driven through a countershaft, as shown in the illustration.



REVERSING MECHANISM.



GASOLINE ENGINE FOR PADDLE-WHEEL BOATS.

The Brush mixing valve is used, by means of which the engine may be run for any length of time at any desired speed from full to one-eighth of normal, throttling and reversing may be arranged to handle from practically any part of the boat. Reversing is

accomplished by simply throwing the lever, shown in the illustration at the right hand, backwards or forwards.

The engine is, of course, of the 4-cycle type, extremely simple and unusually reliable, has copper water jacket, no packing to blow out. Crank shaft, connecting rod, gears and many other working parts are steel drop forgings. Workmanship is of the highest possible grade and all parts are interchangeable. Because of strength and silent running, the use of steel roller chains is recommended, but regular sprocket chain may be used.

The reversing mechanism made by this company for propeller shafts is of the spur-gear type. Gears throughout are cut from solid steel drop forgings. It is strong and well built. It is made at present in sizes suitable for engines up to eight horse power, and while neither as small nor as light as many others, it is not as weak.

Engine and Boat Manufacturers Organized.

The National Association of Engine and Boat Manufacturers was formally organized in New York on June 7. The membership roll is signed by forty-four of the leading manufacturers in these lines from all parts of the country. The charter of the Association under the laws of the State of New York, was received and the constitution and by-laws were adopted. Permanent officers are to be elected at the next meeting, until then, Mr. E. W. Graef will act as Secretary.

The objects of the association are in part as follows: To get special freight rates; to establish a bureau of information; to make special arrangements in regard to and to participate in the profits of shows; to protect its members against adverse legislation and questionable advertising schemes; to bring forward the new and improved methods in construction, and to take such action as will be in the interests of its members as regards alcohol as fuel.

The membership of the association is as follows: The Lozier Motor Company, the Standard Motor Construction Company, the Bridgeport Machine and Motor Company, the Gas Engine and Power Company, the American Iron Works Company, the Buffalo Gasoline Motor Company, the Charles A. Strelinger Company, the Toquet Motor Company, Panhard & Lavoussour, the Matthews Boat Company, the Isham Company, Frederic S. Nock, the Delaware River Motor Company, Palmer Brothers, the Standard Boat Company, the E. Gerry Emmons Corporation, Norwood Brothers & Company, the Eagle Bicycle Company, the Cushman Motor Company, the Wolverine Motor Works, Lacy Brothers, the Chase Pulley Company, A. Barrett's Sons, the Pearson Boat Construction Company, Termadt & Monahan, the Truscott Boat Manufacturing Company, the Pierce Engine Company, the White Craft and Power Company, Charles Durkee & Company, the Smalley Motor Compand, Ltd., the Mianus Motor Company, the Outing Boat Company, the Remy Electric Company, William Roche, the Stamford Motor Company, E. W. Graef, the Smith & Mabley Manufacturing Company, the Milton's Point Ship Yards, T. S. & A. D. Negus, the Electric Launch Company, A. Paterson, the *Motor Boat, Motoring and Boating,* and the *Automobile.*

QUERIES AND ANSWERS.

Q. 218 (*a*)—Is there any good reason why float-feed carbureters cannot be successfully used on two-cycle marine motors?

(*b*) Would not a four-bladed propeller wheel give less vibration to a boat than one with three blades?

(*c*) For a heavy boat 26 feet long, 6 feet beam, standing canopy top, one-half of the boat cabined; and a two-cycle, two-cylinder 8-H. P. motor, each cylinder 5 by 5 inches, what should be the size and kind of propeller to be used to obtain maximum speed and minimum vibration?

I think I want an up-to-date, four-bladed propeller and a good foreign-make carburetor; will you not kindly aid an amateur motor-boat man to obtain best practice? M. W. I.

A.—(*a*) There is no reason why a good float-feed carbureter cannot be used on a marine motor.

(*b*) We do not believe the propeller is the cause of the vibration you mention, unless it is not balanced as it should be.

If properly balanced, a three-bladed propeller will run as well as a two or four-bladed one.

(*c*) For the 8-horse-power double-cylinder 4 inches by 5 inches motor, we would recommend a two-bladed propeller 22 inches diameter, 30 inches pitch. If motor is of the usual style, but if a modern high-speed motor, we would advise making the pitch equal to the diameter and speeding up the motor. There are American carbureters that are the equal of any foreign production, and are more reasonable in price. Some American makes will, with one setting of the needle valve, give a constant mixture at all speeds of the motor, even when used on two-cycle motors, and throttling before the mixture enters the crank case. We know of a two-cylinder two-cycle motor using one float-feed carbureter throttling before the charge enters the crank case that can be run from 200 R. P. M. to 2,000 R. P. M. with fixed spark lead, the speed being entirely controlled by the throttle which forms part of the carbureter.

Q. 221.—I have an Ideal compound engine, 11 and 20 inches by 14 inches, running at 294 revolutions per minute, with a 6-foot pulley wheel from which is driven by a belt a 100-Kw. alternating Stanley machine of 2,400 volts. The pulley on the alternator is 20 inches in diameter. Now, can I substitute an 18-inch pulley and slow down the engine to run 232 revolutions and give better results? E. O. M.

A.—Decreasing the diameter of your driven pulley to 18 inches will allow a proportionate decrease of the revolutions of the engine as 18 is to 20, and still run the alternator at the same speed, thus: $294 \times \frac{18}{20} = 264.6$ turns of the engine. Now, whether your engine can carry the full load at this decreased revolutions is something for the engine makers to decide. You have not stated steam pressure, so we cannot advise you.

Q. 225.—Will you please give me definitions of the following terms, keeping your answer as free from technicalities as possible: "Moment of inertia," "Radius of gyration," "Section modulus"?

A.—These terms arise in discussing the mechanical properties of girders, beams, channels, angles, and shipbuilding shapes in general. For standard shipbuilding shapes the quantities are given in tabulated form in the various handbooks published by the leading steel makers. Their complete explanation would be hardly practicable within the limits of space here available, and we must be content with a brief outline of their mechanical character and relation to the strength of the beam or girder.

The effect of a force or load in producing a bending

stress in a beam depends not only on the amount of the force but on the "advantage" or leaverage with which it acts. The product of force multiplied by arm or leaverage is thus in mechanics shown to be a measure of the effect of the force in producing bending stress in a given beam. This product is known as the *moment* of the force, and the total effect of the external load is the sum of the effects of all its parts, and hence the sum of all the moments, or of the products which are found by multiplying each load by its arm or distance from the particular section, the internal stress in which is under consideration. This sum or measure of the total effect of the external load is then known as the external moment.

This external moment must then be balanced by an internal moment representing the total effect of the internal stresses in opposing or holding against the effect of the external load. Now, it is shown in mechanics that this balance of moments external and internal may be represented by an equation in the form: $M = \frac{p\ I}{y}$, where M represents the external moment and the expression on the right of the sign of equality represents the internal moment. This is built up as shown of three terms, as follows:

p = stress of fiber located at a distance of y from the neutral axis, and if the outermost or farthest fiber is taken, it will then be the greatest stress on the section due to the given load.

I = the moment of inertia of the area of the section about an axis through its neutral axis.

y = distance from neutral axis to the fiber or part of the section in question.

In these definitions we have introduced two terms: *neutral axis* and *moment of inertia,* which themselves need definition, and to which we shall presently come.

When a beam or any member of a structure which acts as a beam is subjected to a cross-breaking load we know that on one side it is thrown into tension and on the other into compression, and we know, furthermore, that these stresses vary with the amount of stretch on one side or compression on the other, as the case may be, and that this stretch or compression is greatest at the extreme outer surfaces of fibers and decreases toward the middle parts of the section. Now, there will be some line lying across the beam section where there is no distortion of the material; a line where the gradually decreasing stretch becomes zero and then changes into a gradually increasing compression. This line is called the *neutral axis,* or, more fully, the neutral axis of the section, and it is shown in mechanics that it passes through the center of gravity of the area of section, and in a direction at right angles to that of the load. Thus, if the load is vertical, as in the case of weights carried, the neutral axis will be horizontal, and is located by finding the center of gravity of the section area and drawing a horizontal line through the same.

The moment of inertia of the area of section about the neutral axis is the sum of an indefinitely large number of partial products, each one of which is formed by multiplying a small element of the area by the square of its distance from the neutral axis. If we suppose the section area cut up into small squares each one-hundredth of an inch square, and thus having an area of .0001 inch, and that each of these areas .0001 square inch is multiplied by the square of its distance from the neutral axis and the products all added, the sum would give a close approximation to the moment of inertia. If, then, we can imagine this process of division of the area carried still further until the number of elements becomes indefinitely large and the area of each one indefinitely small, then, with such subdivision, the sum found by carrying out the operations of multiplication by the square of the distance and addition would give the moment of inertia as used in mechanics. Actually, it is not necessary to find the moment of inertia by any such method as indicated above, as there are methods provided by higher mathematics for readily finding the sum of such an indefinite series of indefinitely small quantities.

If, now, we divide the moment of inertia by the area as a whole, we shall get a mean square of all the arms or distances entering into the final sum. This is readily seen when we note that each partial sum is a product of an element of the area by the square of its arm. If then we divide the sum of such a series of terms by the whole area, the quotient will give the average or mean of all these squares. This average square is then known as the square of the radius of the gyration, and the *radius of gyration* is the square root of the average square. The radius of gyration is thus seen to be a kind of mean arm, but found by taking the square root of the average square. Individually it is not of great significance, and becomes of importance chiefly as a factor or part of the moment of inertia in the strength equation given above.

The *section modulus* is a name given to the quotient of $I \div y$, the moment of inertia, divided by the distance from the outer fiber to the neutral axis; or, in other words, it is the value of the external moment which the beam will support per pound of unit stress at the outer fiber. Thus, if a section modulus is 3 it means that the beam will stand an external moment of 3 for every pound of unit stress on the outer fiber, and hence if 10,000 pounds per square inch may be allowed, then an external moment of $3 \times 10{,}000 = 30{,}000$ inch-pounds may be carried with a developed stress of this value. What this means in terms of load will depend on the length of beam and manner of loading. Thus, if the beam is fixed at one end and loaded at the other, the external moment at the root of the beam where the stress is maximum is the product of the load by length, pounds and inches being the units to be used. Hence, in the case above, a load of 1,000 pounds at an arm of 30 inches, or 500 pounds at 60 inches, or 200 pounds at 150 inches, or any other such combination, would be safely carried. If the beam is supported at both ends and loaded in the middle, then as shown in mechanics the maximum moment will be relatively one-fourth its value in the case just taken, and hence the product of the length by weight at the middle in such case will be 120,000 inch-pounds, and the adjustment between load and length may be anything giving this product. With a beam supported at each end and uniformly loaded throughout its length, the maximum moment will be one-eighth that in the case first taken, and hence the product of total load and length in such case will be 240,000 inch-pounds, and length and total load may be adjusted accordingly. Still other cases may arise, but further

discussion of these points would require more space than can be here provided.

Q. 227.—In the case of a boiler already at work, the escaping gases are found to be about 700 degrees F. I wish to know the proper changes to make to reduce the temperature to what is considered proper, say 500 degress. Also how is the saving gained by the reduction estimated?

A.—With information given it is practically impossible to give any definite answer. It will, therefore, be best to take an assumed case to illustrate the reason for the saving and the method of estimating.

Let us assume a Scotch boiler with 70 square feet of grate surface, working under forced draft and burning 25 pounds of coal per square foot per hour; or 1750 pounds total per hour. In order to burn this coal air must be admitted under and above the grates, the theoretical amount being about 12 pounds per pound of good coal. Actually, however, the necessary amount is far in excess, two or three times the theoretical. With forced draft the excess air required is not as great as with natural draft and in this case we can assume that 25 pounds of air are required per pound of coal, or a total of 43,775 pounds of air must be supplied per hour. The weight of gas passing up the chimney then will be the weight of air plus the weight of coal less the weight of ashes, the ashes are so slight, however, we can omit them in this calculation. We have for the pounds of gas per hour 45,500 or 758 pounds per minute. The specific heat of this gas can be assumed to be .238. Therefore, the British thermal units per degree temperature are $758 \times .238 = 180.1$.

The temperature, as you stated, viz.: 700 degrees, we assumed to be taken at the base of the stack. This is exceedingly high and must be the result of forcing the boiler too hard, not providing sufficient combustion chamber, not having sufficient heating surface in the tubes, or inefficient heating surface. As stated, it is impossible to give a reason for this high temperature without knowing full particulars of the specific case. We will continue with the problem, however, and assume that by some means or other, the gases will be reduced 200 degrees and this heat returned to the boiler.

With 180 B. T. U. per minute for each degree of temperature a reduction of 200 degrees will represent 36,000 B. T. U. To obtain this with a boiler of an efficiency of 70 per cent. would mean the burning of $\frac{36{,}000}{14.000 \times .70}$ or 3.7 pounds. This is equivalent to 220 pounds per hour, or 12.7 per cent. of the total coal burned, an amount well worth endeavoring to save.

With mechanical draft there are two ways in which excessive flue temperatures may be reduced.

One by the Howded system of forced draft, and the other by the Ellis & Eaves system of induced draft. In both of these air heaters are placed in the smoke boxes through which the entering air to the boilers passes and is heated by the exhaust gases. In the first named system the fan drives the air from the heater and into the boiler; in the Ellis & Eaves system, the air is *drawn* through the heater and boiler by the fan which is placed at the base of the stack.

Q. 228.—In the article by Professor Rateau, in your June issue, occurs this statement: "The speed of the turbine must be reduced in proportion to the speed of the ship . . . while the power diminishes approximately as the inverse of the cube of the speed." Will you kindly explain this last statement if it is correct? R. S. R.

A.—The statement would be more correct in the form, "while the power diminishes approximately as the cube of the speed," thus omitting "inverse of the." The statement in this modified form is plainly what is intended, and simply means that the power for steamships varies very nearly as the cube of the speed. This is again a direct result of the fact that resistance varies nearly as the square of the speed, and hence power which represents the product of resistance by speed must vary nearly as the cube of the speed.

Q. 229.—I would like to use the constants in the two following formulas in an example, and therefore ask you to explain how they are derived. Both formulas are for the collapsing pressure of boiler tubes.

1. $P = \frac{9{,}675{,}600 \times t^2}{l \times d}$.

2. $P = \frac{89{,}600 \times t^2}{L \times d}$.

Where t = thickness of plate,
l = length of tube in inches,
L = length of tube in feet,
d = diameter in inches.

W. E. J.

A.—The second formula is derived from the first and is recommended by Lloyd's Register and the U. S. Board of Supervising Inspectors of Steamboats. It is derived by placing the length of the tube in feet instead of inches and by introducing a factor of safety of 9. Thus the constant is reduced by $9 \times 12 = 108$.

The first formula is mostly empirical, derived by Sir Wm. Fairbairn, as a result of extensive experiments on tubes ranging from 4 to 12 inches in diameter and in length from 19 to 60 inches. In some cases further limits are fixed on its application by supplementary formula; but it is generally accepted as the basis for all rules for ascertaining strength of boiler flues. The results of Fairbairn's tests are given in Philadelphia Transactions of 1858.

OBITUARY.

Merchant & Company, Incorporated, Philadelphia, announces with profound sorrow the death of its president, Mr. Clarke Merchant, formerly lieutenant in U. S. N., who died on May 7.

John Riley, for fifteen years president of the United States Metallic Packing Company, died at his home in Philadelphia on April 19, this year, in his seventieth year. Mr. Riley was born in central Pennsylvania, and in his early life took up railroad work. For thirty-one years he was with the Pennsylvania Railroad Company, where he rose to the position of superintendent of transportation. In the early eighties he resigned from this company and associated himself with the United States Metallic Packing Company, where he was held in the highest esteem by officers and employees.

TECHNICAL PUBLICATIONS.

Naval Architecture. By Professor Cecil H. Peabody. Size 6 by 9 inches. Pp. 616, with 218 figures in the text. New York: John Wiley & Sons. Price $7.50.

The purpose of the author in the preparation of this work has been to give in a consistent and connected form the commonly accepted theory of naval architecture. The parts having more immediate relation to the needs of ordinary office work, such as the computations relating to geometrical quantities, stability, propulsion, and strength, are developed in relatively direct and simple form, while of necessity the treatment of waves and rolling is somewhat more intricate. The work as a whole is divided into fourteen chapters as follows:

Chapter I deals with the general subject of integration, both by arithmetical and mechanical processes. A discussion and comparison of various rules for approximate integration is given, together with an explanation of the theory of the more common integrating instruments. The effort toward simplicity has been perhaps too plainly apparent here, and for the needs of the student of the subject a somewhat broader mathematical treatment of several topics in this chapter might be desired. In Chapter II the subjects of displacement and center of buoyancy are discussed, or in general the problems relating to volume, centers of volume, and the allied computation for meta-center. These are discussed relative to various rules for integration and are accompanied by sample forms and computations, showing the application of the methods to actual cases. Chapter III deals with the elementary theory of stability and with a discussion of several methods of computation intended for the usual drawing office investigation of this item. It is followed in Chapter IV by a more generalized treatment of the equilibrium of a floating body, in which the matter is presented from the geometrical viewpoint, with a discussion of the problem of stability in its broader aspects. Chapter V gives a discussion of the simpler problems connected with added or shifted weights on a ship and in particular as regards their effect on the position of equilibrium and on the stability. The same discussion naturally gives an opportunity for discussing the inclining experiment, as well as the influence of liquid cargoes on stability, and the steps needful to secure with such cargoes any desired safe margin. In Chapters VI and VII the somewhat allied topics of grounding, docking and launching are discussed. The computations needful in connection with the latter are discussed, as well as the special questions of stability, load at points on the bottom of the ship, &c., which may arise in connection with these matters. In Chapter VIII the theory of waves is presented to such an extent as is believed to be needful for the purposes of the naval architect. An explanation is given of the constitution and propagation of trochoidal waves on the basis of the approximate or arbitrary assumptions usually made for the elementary treatment of this subject. From this initial point the properties of ocean waves are developed and discussed with special reference to the problems presented to the naval architect and ship captain. The discussion of deep sea waves is followed by a briefer presentation of the subject of shallow water and solitary waves, with especial reference to the differences between these and deep sea waves, and with a brief discussion of the formation of groups of waves and of the group properties. This is naturally followed in Chapter IX by a discussion of the rolling of ships. This is presented by the aid of the usual mathematical equations, which are discussed with reference to both free and unresisted rolling. Only the more simple cases are dealt with, and while the author has in both Chapters VIII and IX used higher mathematics with some freedom, there has been an obvious attempt to limit such use to the lowest amount consistent with some breadth of treatment. It thus results that the discussion is far from complete in many points, and the thorough student of this phase of the subject should consult more specialized works for further important particulars relating to the subject matter of these chapters. In Chapter X the author takes up the general subject of resistance, introducing the discussion with the time honored topic of stream lines and stream line motion, though, naturally, but little later use can be made of the matter thus developed. Approaching the subject from the standpoint of actual observation, the classical experiments of Froude and others are described and their results summarized, and the usual discussion is given of resistance and its constituent parts, skin or frictional resistance and wave or residual resistance. A brief presentation is then given of the law of mechanical similitude and its application to the development of a relation between the residual resistances of geometrically similar ships at "corresponding" speeds.

Chapter XI follows, naturally, with a discussion of the propulsion of ships. The paddle wheel and screw propeller are taken up from the empirical viewpoint, the experiments of Froude furnishing the data for most of the discussion relative to the latter. Methods of propeller design are also discussed, undue weight being perhaps given to methods involving considerable analytical refinement and complexity. In Chapter XII the subject of the power needed to propel a ship at a given speed is taken under discussion from the viewpoints developed in the preceding chapters on resistance and propulsion. The various methods by independent estimate, by comparison, and by the use of the Admiralty and other similar formulæ are discussed and the relations of the methods by Admiralty and like formulæ to the method by comparison are explained and illustrated. In Chapter XIII the subject of steering and manœuvering is discussed relative to the usual approximate theory of the action of the rudder, the resulting path of the ship, as a whole when turning under the influence of the rudder is developed, and the relation of these various matters to the manœuvering characteristics of the ship is explained. In the last Chapter, XIV, the general subject of the strength of a ship is considered with reference to longitudinal stress, and as resulting from the irregular distribution of both weight and buoyancy from one end of the ship to the other. This is supplemented further by a discussion of the strength of a bulk head as determined by the size and distribution of the stiffening material.

The book, as a whole, forms a notable contribution to the literature of theoretical naval architecture, and should prove of value to all students of the subject.

Steam Boilers; Their Theory and Design. By H. de B. Parsons. Size 6 by 9 inches. Pp. 375, with 155 figures in the text. London and New York: Longmans, Green & Company. Price $4.00.

This book comes to fill a decided gap in the technical literature of the day. Between the steam boiler and the steam engine, the two parts of the equipment necessary for the transformation of coal energy into mechanical work, authors have, perhaps, given undue attention to the engine; or, in any event, there is much more literature available regarding the engine than the boiler, both in relation to the practical and theoretical aspects of design, construction, and operation. In the present work the author has proposed to cover this general field for the boiler as it is found in the present engineering practice of the day. The work is divided into sixteen chapters covering the general topics of heat, combustion, fuels, efficiency, boiler performance, draft, materials, detailed design, fittings, stokers, incrustation, corrosion, explosions, chimney design, smoke prevention, testing, operation, and care.

The treatment of the subject throughout is clear, well balanced, and accurate. In the theoretical portions the author has given only such elementary and general discussion as may best serve for a good foundation for an intelligent study of the subject. Many special topics have been quite properly passed over as not coming within the intended scope of the work, but the matter given under this general head will be found, for the most part, to cover the requirements of the engineering student of the subject, and to serve for the general reader as collateral to such specialized works on mechanics and physics as give more extended theoretical treatment of these allied branches.

Thus, in the opening chapters, a brief discussion is given of the general properties of matter, with especial reference to heat and changes of state due to addition or subtraction of heat, followed by the theory of combustion, with formulæ and illustrative examples relating to the total heat of combustion for fuels of various grades and compositions. In connection with the design of boilers, only so much of mechanics is introduced as may serve to intelligently discuss the formulæ employed. In the discussion of riveted joints this simplicity is perhaps carried too far and the reader is left without adequate formulæ or suggestion regarding the proper proportions for the design of modern boiler joints of the highest efficiency.

On the practical side the treatment of the subject is more adequate, and it is clear that it is to this aspect of the subject that the author has intended to give his principal attention. A large amount of useful information is given regarding fuels and the conditions for proper combustion, regarding the points to be held in view in boiler design, regarding the materials available for the construction of boilers, regarding auxiliaries and fittings, draft, stokers, operation, management, etc.

Under the general head of design the discussion of the various governmental and "classification" rules is especially full, as it deservedly should be, since most modern boilers are designed structurally with reference to some such set of rules and requirements.

The treatment is clear, the material well selected, and the author has succeeded admirably in bringing together a well balanced and instructive manual on the modern steam boiler with especial reference to the practical aspects of the many problems which its design and operation may present.

It will find a most acceptable place in the working library of all steam engineers and those interested in steam engineering, and to all such it is most cordially commended.

Entropy or Thermodynamics from an Engineer's Standpoint. By James Swinburne. Size 5 by 7 inches. Pp. 137, with diagrams in the text. New York: E. P. Dutton & Company. Price $1.25.

According to the author the reason for adding another book on thermodynamics to those already in existence is because it is wanted, and it is clear that the author believes himself foreordained to fill this want. The chief purpose of the book is professedly to correct the erroneous notions regarding entropy, which are, according to the author, almost universally prevalent, and to explain the true nature of this physical concept from the practical engineering point of view. To quote from the author's preface: "As far as I am aware there is not any work on the steam or gas engine in this country (England) that gives a correct definition of entropy . . . and when it is added that most treatises on physics, English and foreign, contain incorrect definitions of entropy, and that even some of those specially on thermodynamics are at fault, especially in classing entropy as a factor of heat, there is no need for any apology, at least, for the appearance of a book like this."

When we consider the progress in applied thermodynamics, as shown in the improvements in steam and gas engines during the past 30 years, or covering the period when most of the literature referred to has appeared, we are forced to the conclusion that, sad as is the picture painted by the author regarding the misconceptions relating to entropy, it has had but little effect on the practical progress in the perfection of heat engines, and that in consequence either such practical progress has little dependance on the conceptions of entropy or else the misconceptions have not been so widely spread or so serious as the present author believes. It is probable that there is foundation for both of these views. It is, of course, to be desired that there should be no misconception regarding any subject connected with either theoretical or applied thermodynamics, but it is none the less true that those who have had most to do with the practical improvement of the steam and gas engine have, as a rule, reached their results by methods which did not involve in any marked degree the consideration of the nature of entropy. They were able to reach ultimate truth by other paths and only in an indirect way would entropy or a consideration of its nature enter into their treatment of the problems of applied thermodynamics. On the other hand, it is hardly likely that the misconceptions which this book is to set right have been so serious or so widespread as the author believes. The main burden of the author's treatment seems to relate to the fact that entropy and entropy

relations, as usually stated, are correct only for reversible processes, while most processes with which the engineer has to deal with are irreversible, and the application of entropy relations, and, in particular, the use of the temperature-entropy diagram, requires special modification in dealing with processes of this nature.

It is true that there has been misstatements regarding these matters in the literature of both pure and applied thermodynamics, and authors have not always been as careful as they should have been in discussing irreversible operations by means of methods only strictly applicable to reversible operations. We can scarcely believe, however, that the authors of these various articles and discussions have been ignorant of the limitations of the methods which they may have employed, or that engineers have been to any serious extent led astray in their practical work by such looseness of writing. This is in no wise intended as an excuse for loose writing or for the existence of loosely expressed ideas on engineering or physical science, and we heartily agree with the author that there is room for a full, clear, and authoritative treatment of this subject which might be accepted as final and definitive with regard to the theoretical aspects of this subject and its general relation to practical thermodynamics.

We fear, however, that the present work will hardly meet these specifications. The author's style is obscure and at times confused, if not contradictory. Words are used in more than one significance without due explanation, special and individual points of view are introduced as well as special uses of well-known terms, and without due explanation for the reader. It may be perhaps said that giving the author the benefit of every doubt as to his own ultimate meaning, his views may be considered as in fundamental agreement with the historic development of the subject. It would be no difficult task, however, by taking superficial and perhaps apparent meanings to show him hopelessly at variance with hitherto accepted views and with himself as well.

No such book is likely to exert any serious influence on the development of thermodynamics either pure or applied, and it may be questioned whether the end which the author proposed to himself will be sensibly advanced by his contribution to the subject. If practical engineers or those not already well founded in the subject desire to learn regarding the nature of the entropy concept and its relation to thermodynamic theory, we can hardly advise them to attempt to do so by a perusal of this work.

Logarithms for Beginners. By Charles N. Pickworth. Size 5 by 7 inches. Pp. 43, with tables of four-place logarithms. D. Van Nostrand Company, New York and London. Price 50 cents.

With the increasing use of exponential and other complex formulæ in the calculations relating to all branches of engineering, and especially in thermodynamics, electrical engineering, hydraulics, and marine construction, it is clear that logarithms should be familiar to the modern engineer as a tool of every-day use. The ordinary algebra and the ordinary courses in mathematics in our high schools, and even in our best colleges, are seriously lacking in their treatment of logarithms, and especially from the practical and work-a-day view point. It is to remedy this condition that the author of the present work has prepared this clear and practical presentation of the subject. The author is already well and favorably known by his convenient book on the slide rule, likewise a method of computing by the *mechanical* application of the principles of logarithms. He has now added, in the present work, a more general and detailed discussion of the principles of logarithms with illustrations of their application to various engineering problems. The discussion of the logarithms of fractions is especially good and should aid in clearing up in the mind of the average student or worker with logarithms much of the haze which surrounds their application to numbers less than unity. The illustrative examples are numerous and cover the ground of the usual computations which the engineer is called on to make. A short chapter is given at the close of the book on hyperbolic or Naperian logarithms, showing their character and the manner of obtaining them by transformation from the common logarithm.

The book is written in the clear and simple style which has given such well-deserved popularity to the author of the book on the slide rule, and the present work may properly serve as a complement to the former, the two furnishing together a complete practical discussion of the use of logarithms, one by mechanical and the other by numerical means.

The Metric Fallacy. By Frederick H. Halsey, and **The Metric Failure in the Textile Industry.** By Samuel S. Dale. Size 6 by 9 inches. Pp. 231. New York: D. Van Nostrand Company. Price $1.00.

This book is the outgrowth of a paper presented to the American Society of Mechanical Engineers in 1902, and of the discussion which followed. Part II. has been rewritten and Part I. has been revised and supplemented by additional matter. Part I. deals with the subject from the general viewpoint and includes a discussion of the arguments pro and con regarding the introduction of the metric system, the persistence of old units in various "metric" countries, reasons for the failure of compulsory laws, the industrial loss due to the abandonment of mechanical standards and drawings consequent upon the adoption of the metric system, the "confusion" of the present system of weights and measures, and the claims of superiority for the metric system.

Part II. deals with the application of the metric system in a single branch of industry, and discusses its lack of adaptation to the practical demands in that industry, showing the confusion of old and new standards and units in the present metric countries with reference to textiles and their manufacture.

The authors write vigorously, and as advocates of the superiority of the present system rather than as calm exponents of the two systems, with the choice of selection left to the reader. However great may be the advantages of the metric system for the scientist, and however widely workers in pure science may have adopted such system, it is none the less true that the consensus of opinion among engineers is entirely opposed to the compulsory adoption of the metric system, and that they are in overwhelming proportion agreed on the greater all around practical applicability of our present system to the needs of industry and practical engineering work. The present book is a clear and well written presenta-

tion of the subject matter from this viewpoint, and will take its place as an important contribution to the somewhat rapidly increasing literature of this subject.

The Army and Fleet of Japan. Size 5 by 8 inches. Pp. 58. Paper covers. Paris: Berger, Levrault & Co. Price .75 francs.

This pamphlet is intended to give the most extended and accurate information possible regarding the composition and organization of the land and naval forces of Japan. The work seems to have been done with the greatest care, and, wherever possible, from official sources. Wherever convenient, the information is thrown into tabular form, and a vast amount of information is given regarding the composition, organization, recruiting, and equipment of the two branches of the service, accompanied by lists of naval vessels, with chief particulars, etc. For the technical student of the present war between Japan and Russia this work should prove of great value, as well as to all who may desire the most accurate knowledge obtainable regarding the military and naval forces which Japan has at her disposal.

The Army and Fleet of Russia, with appendix on the Russian Army in Manchuria. Size 5 by 8 inches. Pp. 112. Paper covers. Paris: Berger, Levrault & Co. Price 2 francs.

This work, which is intended as a companion study to "The Army and Fleet of Japan," is also prepared from official and authentic sources, and gives the best possible information regarding the effective military and naval strength of Russia, with especial reference to the present war with Japan. A comprehensive presentation is given of the organization and administration of the army, with such details as would be of most value in estimating its effective fighting strength. The effective strength of the navy is presented in a similar manner, with a tabular showing of the leading characteristics of the Vessels of the Russian navy. The appendix discusses the Russian army in Manchuria and gives the most reliable information and estimates regarding its composition and effective strength. The work, as a whole, seems to be a carefully made special study into this matter of so much present importance, and will be of interest and value to all special students of the present war in the Orient.

Annual Report from Cramp's Shipyard.—President Henry S. Grove of the Wm. Cramp & Sons Ship and Engine Building Company, states in the company's report for the year ending April 30, 1904, that the income for the year shows net earnings from all the company's operations and interests was $188,174.31, most of which has gone toward the liquidation of indebtedness on the company's property. The progress of work in the shipyard has been satisfactory, although there has been little or no profit in shipbuilding proper. The subsidiary companies have earned the profits. There is no new work in immediate sight, but the company's position is safe for the coming fiscal year, as work in all departments amounting to $13,000,000 is now under contract, which is an increase of $1,500,000 for the same period of last year.

SELECTED MARINE PATENTS.

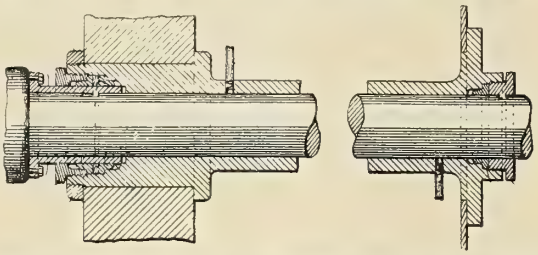
758,656. PILE. GEORGE W. JACKSON AND CORNELIUS HOGAN, CHICAGO, ILL. One claim.

758,841. PROTECTED PILE. CHARLES W. KENNON, TAMPA, FLA. Two claims.

758,983. PROPELLING MECHANISM FOR BOATS. BENJAMIN J. LAVIGN, NEW YORK, N. Y. One claim.

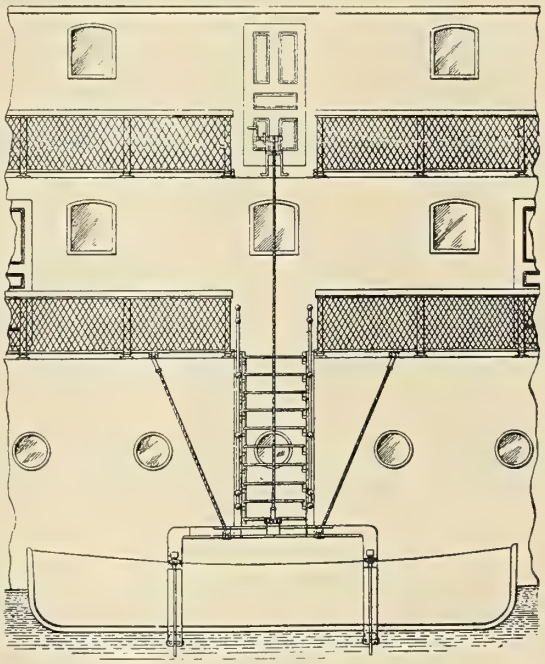
759,238. PADDLE WHEEL. EPHRAIEM CHAQUETTE, NEW ROCHELLE, N. Y. Two claims.

759,323. STERN TUBE FOR SCREW PROPELLER SHAFTS. JAMES STEPHENS, STONEHOUSE, ENG.



Claim.—The outer tube in conjunction with the metal sleeve attached to the propeller boss, the U or hat-shaped packing rings of leather or other suitable material, and the nuts for securing the same substantially as and for the purpose specified. One claim.

759,340. BOAT-LAUNCHING APPARATUS. JACOB BRAUCHLI, HAMPTON, VA.



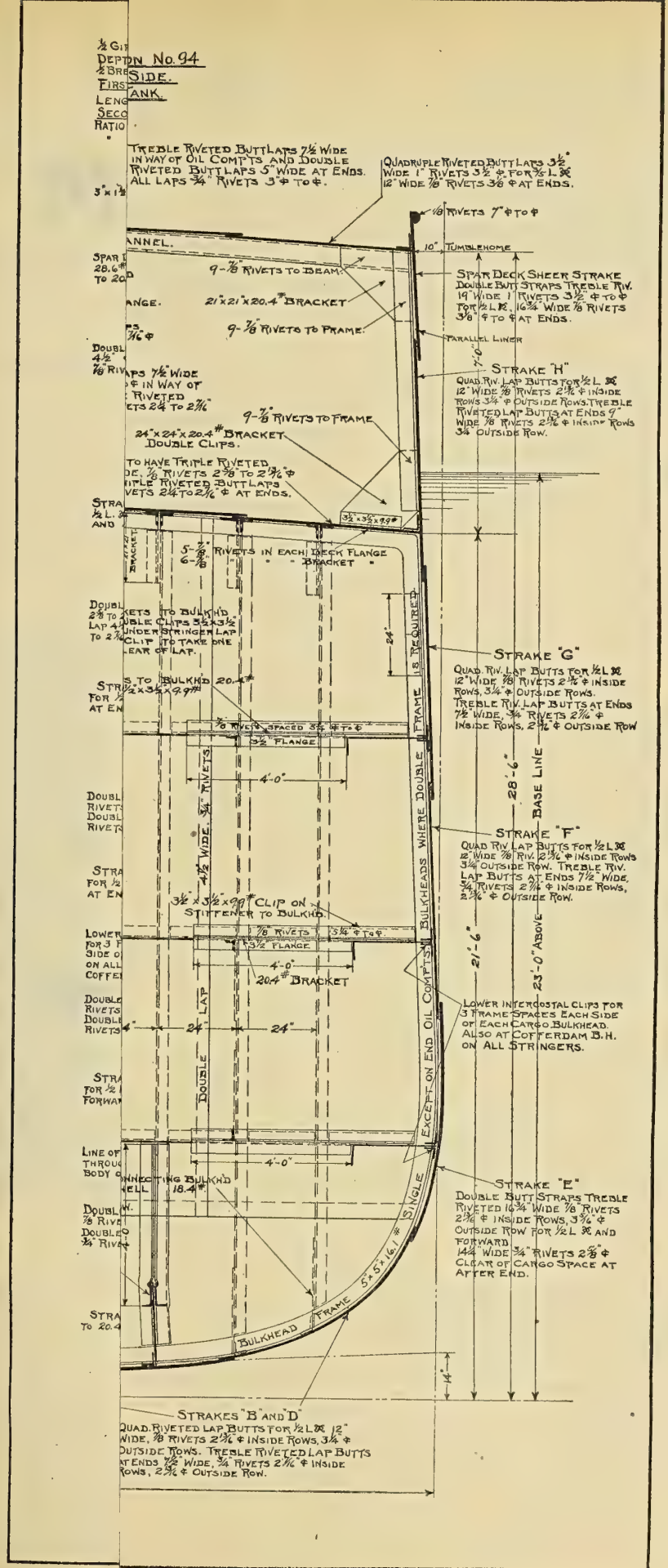
Claim.—In a boat-launching and life-saving apparatus, the combination of a frame or ladder adapted to be hinged at one end to a ship or other support, a cradle at the other end of said frame or ladder, and means for securing a boat on said cradle. Eight claims.

759,536. NAVIGABLE VESSEL. CAREY A. MANKER, PEARL, ILL.

Claim.—The combination with a vessel keel of a screw propeller having its blades on the upward stroke shielded by a part of said vessel keel and on the remainder of the stroke unshielded, substantially as and for the purpose set forth. Six claims.

759,604. WATER-POWER MOTOR OR ENGINE. THOS. E. FRIKE, COATSBURG, ILL. One claim.

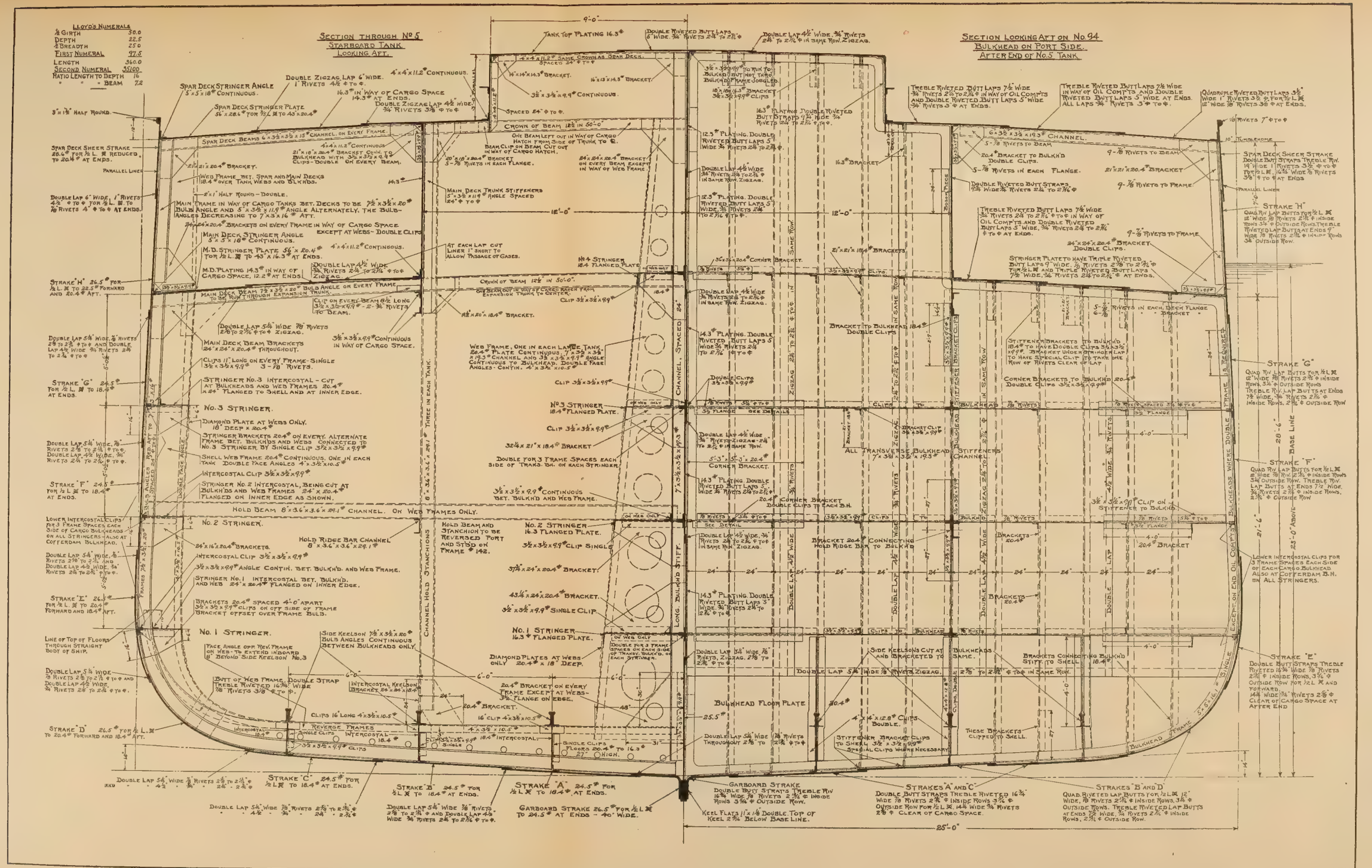
The Engineering Press.—The success of the *Index of the Technical Press* has warranted the publisher to make very great improvements in the character of the paper, beginning with the April number, which was the first issue of the second year of publication. Besides the pages of the magazine have been doubled, and, in addition to the résumés, the *Index* contains a review of the leading engineering question of the month, and many other important features.


SECTION No. 94
SIDE.
TANK.
TREBLE RIVETED BUTT LAPS 7½" WIDE IN WAY OF OIL COMPTS AND DOUBLE RIVETED BUTT LAPS 5" WIDE AT ENDS. ALL LAPS ¾" RIVETS 3" ℄ TO ℄.
QUADRUPLE RIVETED BUTT LAPS 3½" WIDE 1" RIVETS 3½ ℄ FOR ½ L ℋ 12" WIDE ⅞" RIVETS 3⅜ ℄ AT ENDS.
⅞ RIVETS 7" ℄ TO ℄
10" TUMBLEHOME
9-⅞" RIVETS TO BEAM.
21"x21"x20.4# BRACKET
9-⅞" RIVETS TO FRAME.
SPAR DECK SHEER STRAKE DOUBLE BUTT STRAPS TREBLE RIV. 19" WIDE 1" RIVETS 3½" ℄ TO ℄ FOR ½ L ℋ, 16¾" WIDE ⅞ RIVETS 3⅜" ℄ TO ℄ AT ENDS.
PARALLEL LINER
STRAKE "H"
QUAD. RIV. LAP BUTTS FOR ½ L ℋ 12" WIDE ⅞ RIVETS 2⅞" ℄ INSIDE ROWS 3¼" ℄ OUTSIDE ROWS. TREBLE RIVETED LAP BUTTS AT ENDS 9" WIDE ⅞ RIVETS 2⅞" ℄ INSIDE ROWS 3¼" OUTSIDE ROW.
9-⅞" RIVETS TO FRAME
24"x24"x20.4# BRACKET DOUBLE CLIPS.
TO HAVE TRIPLE RIVETED ⅞ RIVETS 2⅜ TO 2¾" ℄ TRIPLE RIVETED BUTT LAPS RIVETS 2¼ TO 2⅜" ℄ AT ENDS.
3½"x3½"x9.9#
5-⅞" RIVETS IN EACH DECK FLANGE
6-⅞ " " BRACKET
24"
FRAME IS REQUIRED
STRAKE "G"
QUAD. RIV. LAP BUTTS FOR ½ L ℋ 12" WIDE ⅞ RIVETS 2⅛" ℄ INSIDE ROWS, 3¼" ℄ OUTSIDE ROWS. TREBLE RIV. LAP BUTTS AT ENDS 7½" WIDE, ¾" RIVETS 2⅜" ℄ INSIDE ROWS, 2⅜" ℄ OUTSIDE ROW
⅞ RIVETS SPACED 3½" ℄ TO ℄
3½" FLANGE
4'-0"
28'-6" BASE LINE
4½" WIDE ¾" RIVETS
STRAKE "F"
QUAD RIV LAP BUTTS FOR ½ L ℋ 12" WIDE ⅞ RIV 2¾" ℄ INSIDE ROWS 3¼" OUTSIDE ROW. TREBLE RIV. LAP BUTTS AT ENDS 7½" WIDE, ¾" RIVETS 2⅜" ℄ INSIDE ROWS, 2⅜" ℄ OUTSIDE ROW.
3½"x3½"x9.9# CLIP ON STIFFENER TO BULKHD.
⅞ RIVETS ¾" ℄ TO ℄
3½" FLANGE
4'-0"
20.4# BRACKET
21'-6"
23'-0" ABOVE
LOWER INTERCOSTAL CLIPS FOR 3 FRAME SPACES EACH SIDE OF EACH CARGO BULKHEAD. ALSO AT COFFERDAM B.H. ON ALL STRINGERS.
24" 24"
DOUBLE LAP
EXCEPT ON END OIL COMPTS
BULKHEADS WHERE DOUBLE
4'-0"
CONNECTING BULKHD 18.4#
STRAKE "E"
DOUBLE BUTT STRAPS TREBLE RIVETED 16¾" WIDE ⅞ RIVETS 2⅜" ℄ INSIDE ROWS, 3⅜" ℄ OUTSIDE ROW FOR ½ L ℋ AND FORWARD 14¼" WIDE ¾" RIVETS 2⅝" ℄ CLEAR OF CARGO SPACE AT AFTER END.
SINGLE
5"x5"x16.1#
FRAME
BULKHEAD
14"
STRAKES "B" AND "D"
QUAD. RIVETED LAP BUTTS FOR ½ L ℋ 12" WIDE, ⅞ RIVETS 2¾" ℄ INSIDE ROWS, 3¼" ℄ OUTSIDE ROWS. TREBLE RIVETED LAP BUTTS AT ENDS 7½" WIDE, ¾ RIVETS 2⅜" ℄ INSIDE ROWS, 2⅜" ℄ OUTSIDE ROW.

OMPANY.

Scale: 1-4 inch = 1 foot.

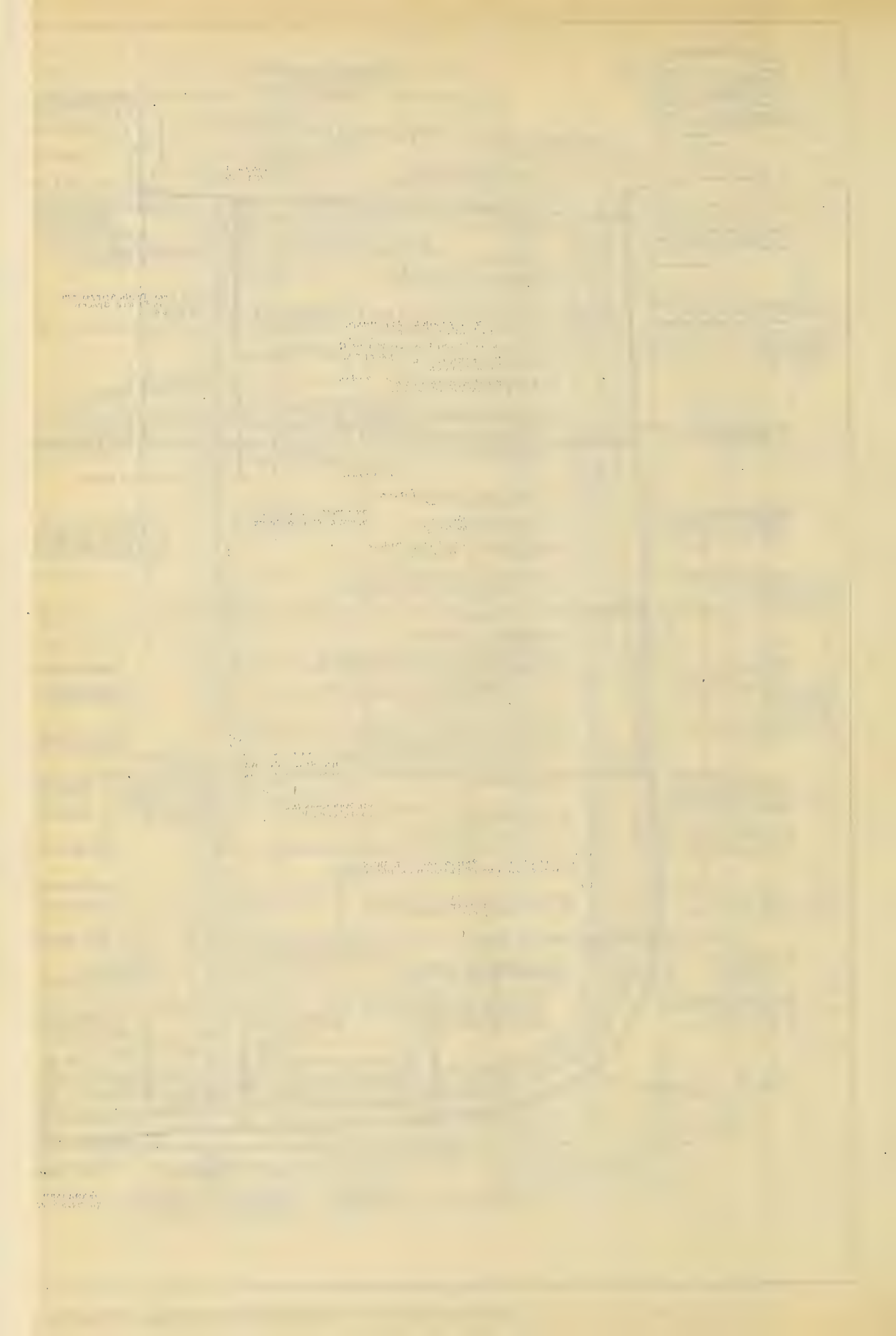
FOR DESCRIPTION SEE PAGE 356.


Lloyd's Numerals
Girth 30.0
Depth 22.5
Breadth 25.0
First Numeral 97.5
Length 360.0
Second Numeral 3600
Ratio Length to Depth 16
" " Beam 7.2
Section through No. 5 Starboard Tank. Looking Aft.
Section Looking Aft on No. 94 Bulkhead on Port Side. After End of No. 5 Tank.
Spar Deck Stringer Angle 5"x5"x18" Continuous.
Spar Deck Stringer Plate 56"x28.4" for 3/4 L.W to 43"x20.4"
Double Zigzag Lap 6" wide. 1" Rivets 4 1/2" @ to @.
16.3" in way of Cargo Space 14.3" at Ends.
Double Zigzag Lap 4 1/2" wide. 3/4" Rivets 3 1/2" @ to @
4"x4"x11.2" Continuous.
Tank Top Plating 16.3"
Double Riveted Butt Laps 6" wide. 3/4" Rivets 2 1/4" to 2 1/2" @
Double Lap 4 1/2" wide. 3/4" Rivets 2 1/2" to 2 1/4" @ in same row. Zigzag.
Spar Deck Beams 6"x3 1/2"x3 1/2"x15" Channel on every Frame.
Spar Deck Sheer Strake 28.6" for 3/4 L.W reduced to 20.4" at Ends.
Parallel Lines
Double Lap 6" wide. 1" Rivets 4 1/2" @ to @ for 3/4 L.W to 7/8 Rivets 4" @ to @ at Ends.
5"x1" Half Round.
8"x1" Half Round - Double.
Web Frame bet. Spar and Main Decks 18.4" over Tank Webs and Bulkheads.
Main Frame in way of Cargo Tanks bet. Decks to be 7 1/2"x3 1/2"x20" Bulb Angle and 5"x3 1/2"x11.9" Angle alternately. The Bulb-Angles Decreasing to 7"x3"x16" Att.
24"x24"x20.4" Brackets on every Frame in way of Cargo Space except at Webs - Double Clips
Main Deck Stringer Angle 5"x5"x18" Continuous.
M.D. Stringer Plate 56"x20.4" for 1/2 L.W to 43"x16.3" at Ends.
M.D. Plating 14.3" in way of Cargo Space, 12.2" at Ends.
4"x4"x11.2" Continuous.
Double Lap 4 1/2" wide. 3/4" Rivets 2 1/4" to 2 1/2" @ to @
Strake "H" 26.5" for 1/2 L.W to 22.5" Forward and 20.4" Aft.
Main Deck Beam 7 1/2"x3 1/2"x20" Bulb Angle on every Frame to be run through Expansion Trunk.
Clip on every Beam 8 1/2" long 3 1/2"x3 1/2"x9.9" - 2-3/4" Rivets to Beam.
Double Lap 5 1/2" wide 7/8" Rivets 2 1/2" to 2 1/4" @ to @ Zigzag.
Main Deck Beam Brackets 24"x24"x20.4" throughout.
Double Lap 5 1/2" wide 7/8" Rivets 2 1/2" to 2 1/2" @ and Double Lap 4 1/2" wide 7/8 Rivets 2 1/4" to 2 1/4" @ to @
Clips 11" long on every Frame - Single 3 1/2"x3 1/2"x9.9" 3 - 7/8 Rivets.
Strake "G" 24.5" for 1/2 L.W to 18.4" at Ends.
Stringer No. 3 Intercostal - cut at Bulkheads and Web Frames 20.4" x 24" Flanged to Shell and at Inner Edge.
No. 3 Stringer.
18" Deep x 20.4"
Diamond Plate at Webs Only.
Stringer Brackets 20.4" on every Alternate Frame bet. Bulkheads and Webs connected to No. 3 Stringer by Single Clip 3 1/2"x3 1/2"x9.9"
Double Lap 5 1/2" wide. 7/8" Rivets 2 1/8" to 2 1/4" @ to @. Double Lap 4 1/2" wide. 3/4" Rivets 2 1/4" to 2 1/2" @ to @.
Shell Web Frame 20.4" Continuous. One in each Tank. Double Face Angles 4"x3 1/2"x10.5"
Strake "F" 24.5" for 1/2 L.W to 18.4" at Ends.
Intercostal Clip 3 1/2"x3 1/2"x9.9"
Stringer No. 2 Intercostal, being cut at Bulkheads and Web Frames 24"x20.4" Flanged on Inner Edge as shown.
Hold Beam 8"x3.6"x3.6"x21.1" Channel. On Web Frames Only.
Lower Intercostal Clips for 3 Frame Spaces, each side of Cargo Bulkheads on all Stringers - Also at Cofferdam Bulkhead.
No. 2 Stringer.
Hold Ridge Bar Channel 8"x3.6"x3.6"x21.1"
24"x16"x20.4" Brackets.
Double Lap 5 1/2" wide. 7/8" Rivets 2 1/8" to 2 1/4" @ and Double Lap 4 1/2" wide. 3/4" Rivets 2 1/4" to 2 1/2" @ to @.
Intercostal Clip 3 1/2"x3 1/2"x9.9"
3 1/2"x3 1/2"x9.9" Angle Contin. bet. Bulkh'd. and Web Frame.
Stringer No. 1 Intercostal bet. Bulkh'd. and Web 24"x20.4" Flanged on Inner Edge.
Strake "E" 26.5" for 1/2 L.W to 20.4" Forward and 18.4" Aft.
Brackets 20.4" spaced 4'-0" apart 3 1/2"x3 1/2"x9.9" Clips on off side of Frame Bracket offset over Frame Bulb.
Line of Top of Floors through Straight Body of Ship.
No. 1 Stringer.
Face Angle opp. Rev. Frame on Web - to extend inboard 8" beyond Side Keelson No. 3
Side Keelson 7/8"x3 1/2"x20" Bulb Angles Continuous between Bulkheads only.
Butt of Web Frame. Double Strap Treble Riveted 16.3" wide 7/8 Rivets 3/8" @ to @.
Double Lap 5 1/2" wide 7/8 Rivets 2 1/8" to 2 1/4" @ to @ and Double Lap 4 1/2" wide. 3/4 Rivets 2 1/4" to 2 1/4" @ to @.
Intercostal Keelson Bracket 24"x24"x18.4"
Strake "D" 26.5" for 1/2 L.W to 20.4" Forward and 18.4" Aft.
Reverse Frames
Intercostal 18.4"
Angle Clips
3 1/2"x3 1/2"x9.9" Clips
Clips 16" long 4"x3 1/2"x10.5"
Double Lap 5 1/2" wide 7/8 Rivets 2 1/8" to 2 1/4" @
Strake "C" 24.5" for 1/2 L.W to 18.4" at Ends.
Strake "B" 24.5" for 1/2 L.W to 18.4" at Ends.
Strake "A" 24.5" for 1/2 L.W to 18.4" at Ends.
Garboard Strake 26.5" for 1/2 L.W to 24.5" at Ends - 40" wide.
Crown of Beam 12 1/2" in 50'-0"
One Beam left out in way of Cargo Hatch from side of Trunk to C.
Beam Clip on Beam Cut out in way of Cargo Hatch.
20"x18"x20.4" Bracket 5-7/8 Rivets in each Flange.
4"x4"x11.2" Continuous.
21"x18"x20.4" Bracket Contin. to Bulkhead with 3 1/2"x3 1/2"x9.9" Clips - Double on every Beam.
84"x24"x20.4" Bracket on every Beam except in way of Web Frame.
Main Deck Trunk Stiffeners 5"x3 1/2"x11.9" Angle Spaced 24" @ to @
No. 4 Stringer 18.4" Flanged Plate.
Man Way
At each Lap cut Liner 1" short to allow passage of Gases.
Double Lap 4 1/2" wide 3/4 Rivets 2 1/4" to 2 1/2" @ to @ in same row. Zigzag.
Crown of Beam 12 1/2" in 50'-0"
One Beam cut in way of Cargo Hatch from Expansion Trunk to Centre.
Clip 3 1/2"x3 1/2"x9.9"
18"x20"x18.4" Bracket
Web Frame. One in each large Tank. 20.4" Plate Continuous 7"x3 1/2"x3 1/2"x19.3" Channel and 3 1/2"x3 1/2"x9.9" Angle Continuous to Bulkhead. Double Face Angles - Contin. 4"x3 1/2"x10.5"
Clip 3 1/2"x3 1/2"x9.9"
No. 3 Stringer 18.4" Flanged Plate.
Clip 3 1/2"x3 1/2"x9.9"
32 1/4"x21"x18.4" Bracket
Double for 3 Frame Spaces each side of Trans. Bh. on each Stringer.
3 1/2"x3 1/2"x9.9" Continuous bet. Bulkh'd and Web Frame.
No. 2 Stringer 16.3 Flanged Plate.
Hold Beam and Stanchion to be Reversed Port and Stbd on Frame # 142.
3 1/2"x3 1/2"x9.9" Clip Single
37 1/4"x24"x20.4" Bracket
43 1/4"x24"x20.4" Bracket
3 1/2"x3 1/2"x9.9" Single Clip.
No. 1 Stringer 16.3" Flanged Plate.
Diamond Plates at Webs only 20.4"x18" Deep.
20.4" Bracket on every Frame except at Webs - 3/8" Flange on edge.
20.4" Bracket.
16" Clip 4"x3 1/2"x10.5"
Bulkhead Floor Plate 30.4"
25.5"
Double Lap 5 1/2" wide throughout 2 1/8" to 2 1/4" @ to @
Keel Flats 1"x 1/8" Double. Top of Keel 2 3/4" below Base Line.
Garboard Strake Double Butt Straps Treble Riv 16 3/4" wide 7/8 Rivets 2 3/4" @ Inside Rows 3 1/4" @ Outside Row.
Strakes "A" and "C" Double Butt Straps Treble Riveted 16 3/4" wide 7/8 Rivets 2 3/4" @ Inside Rows 3 1/4" @ Outside Row for 1/2 L.W. 14 1/4 wide 3/4 Rivets 2 1/8" @ Clear of Cargo Space.
Strakes "B" and "D" Quad. Riveted Lap Butts for 1/2 L.W 12" wide, 7/8 Rivets 2 3/4" @ Inside Rows, 3 1/4" @ Outside Rows. Treble Riveted Lap Butts at Ends 7 1/2" wide 3/4 Rivets 2 1/4" @ Inside Rows, 2 3/4" @ Outside Row.
Treble Riveted Butt Laps 7 1/2" wide 3/4 Rivets 2 1/2" to 2 3/4" @ to @ in way of Oil Compts and Double Riveted Butt Laps 5" wide. 3/4 Rivets 3" @ to @ at Ends.
Treble Riveted Butt Laps 7 1/2" wide 3/4 Rivets 2 1/2" to 2 3/4" @ to @ in way of Oil Compt's and Double Riveted Butt Laps 5" wide at Ends. All Laps 3/4" Rivets 3" @ to @.
Quadruple Riveted Butt Laps 3 1/2" wide 1" Rivets 3 1/2" @ for 3/4 L.W 12" wide 7/8 Rivets 3.8" @ at Ends.
1/8 Rivets 7" @ to @
10" Tumblehome
6"x3 1/2"x3 1/2"x19.3" Channel.
5-7/8 Rivets to Beam.
20.4" Bracket to Bulkh'd Double Clips.
5-7/8 Rivets in each Flange.
9-7/8 Rivets to Beam.
21"x21"x20.4" Bracket
9-7/8 Rivets to Frame
Double Riveted Butt Straps 7 1/2" wide 3/4 Rivets 2 1/4" to 2 3/4" @
Spar Deck Sheer Strake Double Butt Straps Treble Riv. 14" wide 1" Rivets 3 1/2" @ to @ for 3/4 L.W. 16 1/2" wide 7/8 Rivets 3/8" @ to @ at Ends
Strake "H" Quad. Riv. Lap Butts for 1/2 L.W 12" wide 7/8 Rivets 2 3/4" @ Inside Rows 3 1/4" @ Outside Rows Treble Riveted Lap Butts at Ends 9" wide 7/8 Rivets 2 3/4" @ Inside Rows 3 1/4" @ Outside Row.
24"x24"x20.4" Bracket Double Clips.
Stringer Plate to have Triple Riveted Butt Laps 9" wide. 7/8 Rivets 2 3/8" to 2 3/4" @ for 1/2 L.W and Triple Riveted Butt Laps 7 1/2" wide. 3/4 Rivets 2 1/2" to 2 3/4" @ at Ends.
Bracket Tp Bulkhead 18.4" Double Clips
Stiffener Brackets to Bulkh'd 18.4" to have Double Clips 3 1/2"x3 1/2"x9.9" Bracket under Stringer Lap to have Special Clip to take one Row of Rivets Clear of Lap
Corner Brackets to Bulkh'd 20.4" Double Clips 3 1/2"x3 1/2"x9.9"
All Transverse Bulkhead 7"x3 1/2"x3 1/2"x19.3"
Stiffeners Channel.
Corner Bracket.
Corner Bracket Double Clips to each B.H.
3 1/2"x3 1/2"x9.9" Clip on Stiffener to Bulkhd.
Bracket 20.4" Connecting Hold Ridge Bar to Bulkh'd
Brackets 20.4"
Side Keelsons Cut at Bulkheads and Bracketed to Same.
Brackets Connecting Bulkhd Stiff. to Shell.
Double Lap 5 1/2" wide 7/8 Rivets Zigzag.
Bulkhead Floor Plate 30.4"
4"x4"x12.8" Clips Double.
Stiffener Bracket Clips to Shell 3 1/2"x3 1/2"x9.9" Special Clips where necessary.
These Brackets Clipped to Shell.
Strake "G" Quad Riv Lap Butts for 1/2 L.W 12" wide 7/8 Rivets 2 3/4" @ Inside Rows, 3 1/4" @ Outside Rows Treble Riv Lap Butts at Ends 7 1/2" wide, 3/4" Rivets 2 1/4" @ Inside Rows, 2 3/4" @ Outside Row
Strake "F" Quad Riv Lap Butts for 1/2 L.W 12" wide 7/8 Rivs 2 3/4" @ Inside Rows 3 1/4" Outside Row. Treble Riv Lap Butts at Ends 7 1/2" wide, 3/4 Rivets 2 1/4" @ Inside Rows, 2 3/4" @ Outside Row
Strake "E" Double Butt Straps Treble Riveted 16 3/4" wide 7/8 Rivets 2 3/4" @ Inside Rows, 3 1/4" @ Outside Row for 1/2 L.W and forward. 14 1/4" wide 3/4 Rivets 2 1/8" @ Clear of Cargo Space at After End
Lower Intercostal Clips for 3 Frame Spaces each side of each Cargo Bulkhead. Also at Cofferdam B.H. on all Stringers.
Base Line
23'-0" above
21'-6"
28'-6"
25'-0"

MIDSHIP SECTION OF OIL BARGES NOS. 94 AND 95, OF THE STANDARD OIL COMPANY, BUILT BY THE TOWNSEND-DOWNEY SHIPBUILDING COMPANY.

Scale: 1-4 inch = 1 foot.

FOR DESCRIPTION SEE PAGE 356.



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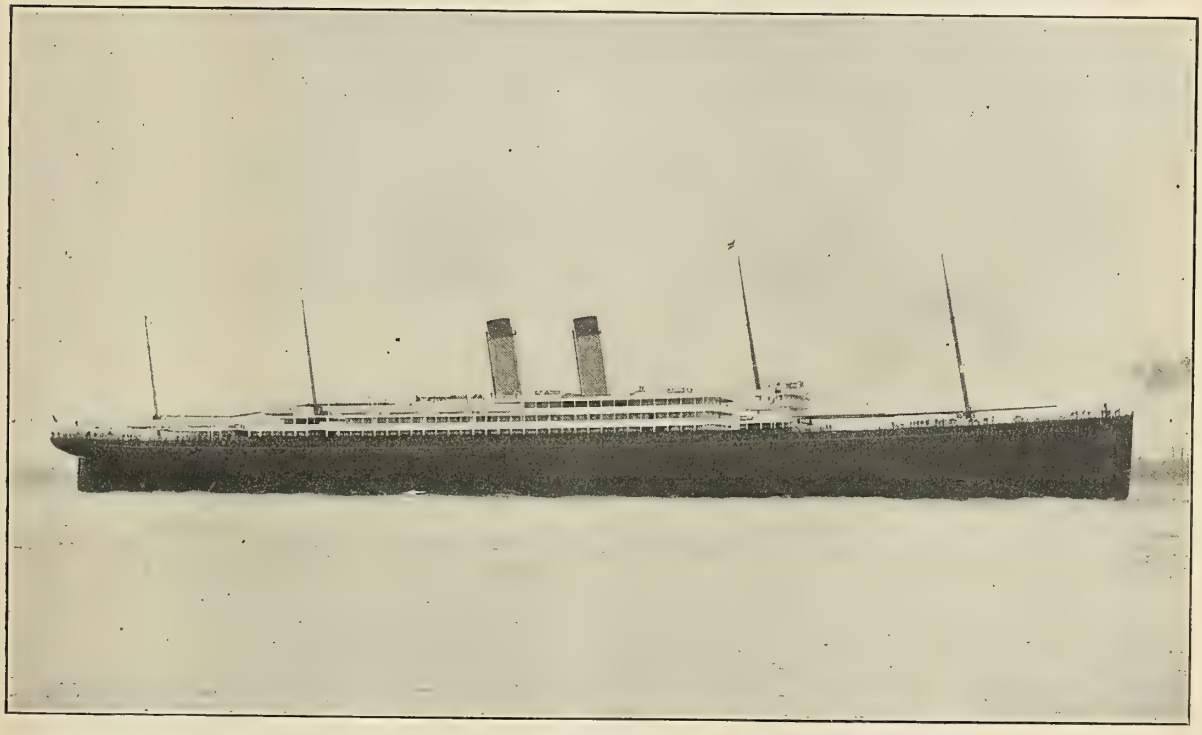
Marine Engineering

Vol. IX. AUGUST, 1904. No. 8.

TWIN-SCREW STEAMSHIP BALTIC, OF THE WHITE STAR LINE, THE LARGEST SHIP AFLOAT.

The White Star line has again demonstrated its intention to operate steamers of the largest type by placing in commission the new steamer *Baltic,* the largest ship afloat. In the *Cedric* and *Celtic* this line possesses two steamers which have held the record as the largest steamers, but the *Baltic,* registering 24,000 tons, exceeds them by 3,000 tons. The cargo capacity is about 28,000 tons, and the displacement at normal draft about 40,000 tons. The ship is 726 feet long, or 26 feet longer than the steamers above named, and with her two funnels and four pole masts she strongly resembles them.



NEW TWIN-SCREW STEAMSHIP BALTIC, OF THE WHITE STAR LINE, THE LARGEST SHIP AFLOAT.

The Baltic, which completed a successful maiden voyage from Queenstown to New York on Friday, July 8, was turned out from the yard of Harland & Wolff, Belfast, builders of all the recent White Star steamers. There are in all six steel decks, up to and including the weather or shelter deck, and above this is built amidships a large deck house with three promenade decks extending the full width of the ship. The other deck erections will be mentioned later. The shell plating is laid in inside and outside strakes, and the three strakes between main and upper decks are doubled. In appearance the sides of the ship are notable for the absence of ports, for outside of the coaling ports there are but one port with swinging doors forward and one aft on each side. The framing throughout is of channels, which section is also largely used for deck beams.

In describing this ship we will first briefly mention the arrangement from forward aft, of the hatches, masts, deck erections, and the numerous cargo-handling machinery with which the ship is so completely equipped. A double Napier windlass is placed in the forecastle and in addition drives two capstans' heads. The enormous anchors are of the stockless type. Directly aft is a winch with extended shaft for gypsy heads, made by J. H. Wilson & Company. Next comes hatch No. 1, with two winches at the after side, then the foremast with four cargo booms. Next two winches are placed for working hatch No. 2, at the after end of which is also another winch. Hatch No. 3 has two winches on the after side, close to first deck erection, which is the

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officers' deck house, with an entrance to the first cabin staterooms below. On the forward side of this house are mounted two cargo booms. The main mast is stepped directly aft of this house with hatch in the wake. Two winches for handling the cargo for this hatch are placed on this deck house and two boats are swung on the upper deck. Next comes the main deck house, from which rise the two funnels. A flying bridge leads from the wheel house and navigation bridge to the top of this structure.

On the boat deck eight life boats are swung on ordinary davits. Cargo hatch No. 5 is between the main superstructure and the house built for the second cabin passengers. On top of house are two winches, two boats, and eight collapsible boats, and through it rises the mizzen mast, fitted with three cargo booms. Following in order come two winches, cargo hatch No. 6, with a winch and four boats mounted on the top of a flying bridge, hatch No. 7, two more winches, the spanker mast and two cargo winches, a winch with two extended gypsy heads, two Napier warping capstans, and the steering engine mounted in a steel house.

The hatches for the passengers and crew are not included in the above summary. The steering engine is of the Wilson & Pirrie type, and consists of two sets of double engines mounted on sliding bases and driving through reduction and spur gears the rudder quadrant. One of these double engines is held in reserve in case the other one should give out, when the base may be quickly shifted and the gearing engaged and the disabled engine likewise disengaged. One valve controls the steam for both the cylinders, and is of the usual type.

With these points in mind, a brief description of the general arrangement of the decks will serve to convey an approximate idea of this immense vessel.

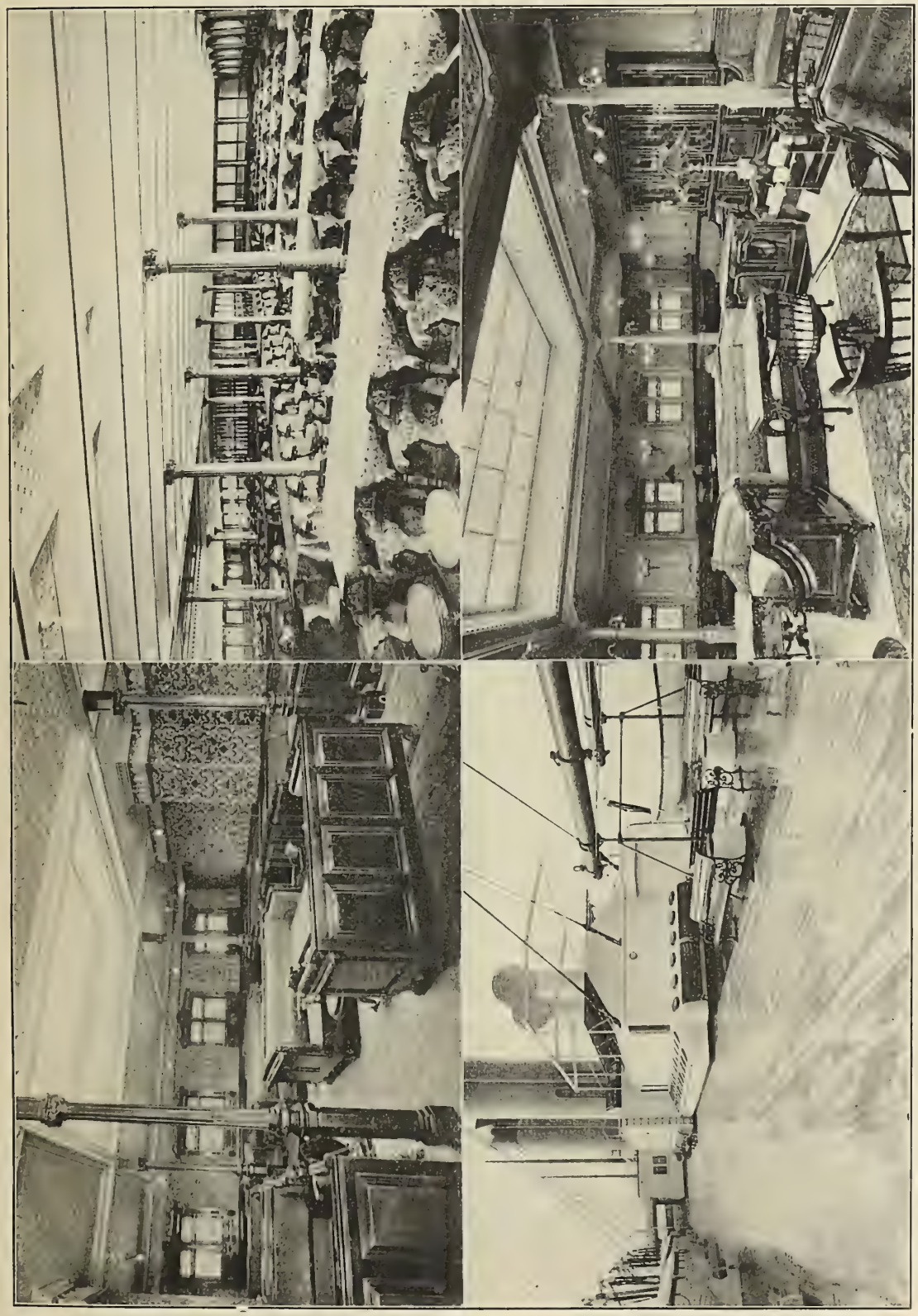
First-class passenger accommodations are provided amidships, on the upper and shelter decks, and in the midship superstructure. The forward part of the top deck is thrown open to the passengers, forming one of the finest large sun decks imaginable. The ship's compass is mounted high above the saloon skylight. Descending to the upper promenade or boat deck a beautiful large library extends across the forward end of the the house. This library opens from a lobby with skylight above and stairway descending to all decks of the first-cabin passenger accommodations. A handsome smoking room is entered from a passage on the port side, which is well lighted through white and gold crystal windows and skylight. The arrangement and general effect of this room are shown in the illustration on page 351. On the deck below, or the promenade deck, are placed many of the state rooms, entered from passage ways fore and aft on each side of the ship. Cross passages lead to bath and toilet rooms, which are equipped with the latest and most approved heavy porcelain ware. Many of the state rooms are arranged ensuite with bath room and sitting room connecting. The floors of the lobby on all decks are laid with large squares of white rubber tiling and the passage ways with interlocking tiling. The finish of the lobbies is polished oak and of the passage ways white enamel. The state rooms are of white enamel and mahogany furnishing. In each room are two berths with upper one arranged to fold up, a broad settee, a folding combined lavatory and desk, and a clothes press. Electric lights and call bells are provided and each room is heated by an independent electric heater. The arrangement of accommodations on the spar deck is practically the same as on the promenade deck. Mention should be made of the unobstructed broad promenade space on each of these three decks. Again descending, the passenger arrives on the main saloon deck. The landing is a glass-enclosed lobby opening into the main dining saloon which extends from side to side of the ship and is provided with tables for seating 370 people. The design of this room has been carefully chosen to present a light and airy appearance. The ceiling is in white panels set up with gold. The saloon is well lighted in day time by the side lights and a large crystal central dome with white and gold leaded glass. Panels surrounding the dome are painted with views of American and English landscapes. Numerous individual electric lights are distributed over the ceiling panels, and behind the crystal dome for illuminating at night time. Ventilation is secured by exhaust air ducts connected with the sky light and by trunk ventilators placed in the ceiling on line with the deck house above. The revolving chairs are of mahogany with tapestried seats; the floor is laid in light wood. The remaining first-class state rooms are forward of the dining saloon and on the starboard side aft of the saloon. The pantry adjoints the dining saloon on the port side, and aft of it is the galley for first and second cabins.

The second-class dining saloon is on the starboard side aft of the first-cabin accommodations. The equipment and furnishings of this saloon, as well as of the state rooms, are but slightly inferior to those of the first cabin. The second-class state rooms are reached by descending to the deck below, *i.e.*, main deck. The entrance to the second cabin is from a deck house in which are the smoking room and library, each very comfortably furnished, the latter shown on page 353.

In arranging for passenger accommodations, the company has not slighted the third cabin or steerage; in fact, it is the accommodations for this class of passengers that the *Baltic* presents unique features. The White Star line has always made a point of equipping the third cabin in better than the ordinary style. Dining saloons, fitted with long tables and revolving chairs (the meals are served by regular stewards), state rooms with two, three and four berths, and ample toilet rooms, make up the third-class accommodations. Ventilation is provided the second and third cabins by means of large steel air ducts placed overhead in the passages directly below the deck beams, carrying fresh air to all parts. Ample promenade space is allotted for the passengers of these classes. The first cabin has accommodations for a maximum of 425, the second cabin 250, third cabin from 1,270 to 2,000, and the crew numbers 350.

MAIN ENGINES.

The *Baltic* is fitted with two sets of four-cylinder, quadruple-expansion engines of about 7,000 horse power each, of the usual type turned out by the builders for vessels of this class, and practically identical to the engines of the *Cedric* and *Celtic*. The engine room is very roomy and extends the full width of the ship, with recess in after bulkhead for thrust bearings, and on



VIEWS OF THE FIRST-CABIN ACCOMMODATIONS ON THE NEW TWIN SCREW STEAMSHIP BALTIC.

Dining Saloon
Library.
Smoking Room
Boat Deck, Looking Forward.

lower deck with recess for electric-light plant. A Howden centrifugal fan is placed on forward and after engine room hatch casing for ventilating the engine room. The arrangement of the cylinders and valves of main engines is as follows: h. p. piston valve, high-pressure cylinder, second intermediate cylinder, two 2d i. p. piston valves, l. p. slide valve, low-pressure cylinder, first intermediate cylinder, 1st i. p. piston valve. The diameters of the cylinders are 33, 47 1-2, 68 1-2, 98, and the stroke is 63 inches. The working pressure is 210 pounds. The end cylinders are cast with their respecting valves, while the valves of the middle cylinders are in separate castings and bolted in place. The cylinders are mounted on eight cast-iron housings of box section, the housings being tied at the top front and back by heavy horizontal cast-iron girders. The condenser is built in the framing of the low and first intermediate-pressure cylinders, and the air pump is driven by levers from the first intermediate cross head. Each cylinder is free to expand separately and yet the construction of columns forms a very rigid support. The bed plate is of cast-iron box section and in four parts. The valves are operated by Stephenson double-link motion with double cylinder reversing engine mounted on the front second intermediate column. The double ported slide valve of the low-pressure is fitted with a balanced piston.

The main pistons are conical and of cast iron. Ramsbottom packing rings are used. Tail rods are fitted on the second intermediate and low-pressure pistons. Piston rods are forged steel 9 3-8 inches diameter, and the cross heads are malleable steel fitted with cast-iron adjustable shoes lined with white metal. The connecting rods have forked upper ends, and are of mild forged steel 11 feet 10 inches between centers, 9 1-4 inches diameter at top, and 10 1-2 inches at bottom. The boxes at top and bottom are of phosphor bronze. The crosshead guides on both front and back columns are of cast iron with hollow backs for water circulation, and are removable and adjustable. The crank shaft is of the built-up type, in four sections, 19 1-4 inches in diameter with a 2 1-2-inch bored hole. The pins are 19 1-2 inches long and 20 inches diameter. All is of mild steel, which material is used for the rest of the shaft. The turning engine is placed on the condenser opposite the center coupling of the crank shaft and is driven by double engine and worm gear. The arrangement of cranks is on the Yarrow, Schlick, Tweedy system and the sequence is as follows: high-pressure, 1st intermediate, 2d intermediate, low-pressure. The thrust shaft is 18 3-4 inches diameter with ten colors. The horse-shoe bearings are cored out for salt-water circulation and are lined with white metal.

The line shaft is in 8 sections 18 3-4 inches diameter and the propeller shaft is 19 5-8 inches diameter. The stern tube is of cast iron. The main journals of the crank shaft are eight in number, the end ones being 26 inches long and the remaining six 24 inches long. Steady bearings are at either end of the thrust block and in the shaft alleys there are 15 bearings. The engine is equipped with complete water and oil service. The columns of the main engine are used as oil reservoirs. An Aspinwall governor is fitted on the high-pressure cross head of each engine.

Each main condenser contains 2,153 copper tinned tubes arranged in two nests. The cooling surface of each is about 9,000 square feet. Two bilge and two sanitary pumps are driven from the air-pump cross head. Steam for all auxiliaries, except the feed pumps, is reduced to 100 pounds pressure.

AUXILIARIES.

The auxiliaries are in duplicate throughout, each engine being entirely independent of the other. Following are given the total number of both engines:

2 circulating centrifugal pumps, driven by single engine.
5 Weir feed pumps.
3 Westminster ballast pumps.
1 Quiggins' feed-water heater.
1 Quiggins' evaporator.
2 Railton & Campbell's grease extractors.
3 ballast pumps.
7 duplex pumps for various ship uses.
1 ash-ejector pump.

A large refrigerating plant is located amidships forward of the boiler rooms and consists of a triple-expansion, two-crank engine, driving two carbonic anhydride compressors built by the J. E. Hall Company. The engine is of the horizontal type, the high and intermediate cylinders being tandem with one of the compressors and the low-pressure cylinder tandem to the

Marine Engineering Data Card. **August 1, 1904.**

Name—Baltic. Nationality—British. Type—Ocean passenger and freight.
Launched—1903. Builder—Harland and Wolff. Owner—White Star Line.

Length over all	726 ft. 0 ins.
Breadth, molded	75 " 0 "
Depth	49 " 0 "
Registered tons, about	24,000 tons
Cargo capacity, "	28,000 "
Displacement, "	40,000 "
Engines	two; four-cylinder, quadruple
Cylinder diams	33, 47 1-2, 68 1-2, 98 ins.
Stroke	63 "
Valves	piston, except L. P. slide
R. P. M., sea	78
I. H. P.	14,000
Speed	17 knots
Condensers (2), cool. surf.	18,000 sq. ft.
Shafting diam., crank, 19 1-4 ins.; pins, 20 ins.	
" thrust and line,	18 3-4 ins.
" " propeller,	19 5-8 "
Piston rods, diam.	9 3 8 "
Connecting rods, diam.,	9 1-4 ins top, 10 1-2 ins. bottom
" rods, dis. bet. centers,	11 ft, 10 ins.
Propellers	two, three blades
Pitch	24 ft. 6 ins.
Diameter	20 " 0 "
Area	99 sq. ft.
Boilers	eight double-end Scotch
Pressure	210 lbs.
Diameter	15 ft. 6 ins.
Length	19 " 6 "
Plates	1 19-32
Tubes	852 each, 2 5-8 ins. o. d.
" length	7 ft. 10 ins.
Furnaces: No. each boiler	6
Diam., outside	48 3-8 ins.
G. S., total	1,008 sq. "
H. S., "	41,680 "
Draft	natural

second compressor. In the engine base is condenser, and direct connected to shaft are air and circulating pumps. The two carbonic anhydride condensers are the same compartment for ship stores purposes, equal to 7 1-2 tons per 24 hours.

The electric-lighting plant is placed in a recess at the

SECOND-CABIN SMOKING ROOM, TWIN-SCREW STEAMSHIP BALTIC.

ONE OF THE DINING ROOMS OF THE THIRD CABIN, TWIN-SCREW STEAMSHIP BALTIC.

separate. The capacity of this plant, which is used for chill rooms in the cargo space, is 54 tons of ice per day. Another smaller Hall refrigerating plant is mounted in after end of engine room, and comprises four direct-connected sets made by W. H. Allen, Son & Company. The engines are two-crank compound, 12 and 20 inches

by 12 inches stroke, with piston valve, and run at 230 revolutions. Six-pole generators are wound for 102 volts and 750 amperes. The sets are connected for parallel running and the wiring is of the two-wire system, while the third wire connecting the machines acts as an equalizer. For grinding the commutators in place, a motor-driven grinder may be attached to each machine. The engines are very compact and strongly built with cast-iron housings at the back and two wrought-iron columns at the front. Solid cross heads are fitted with tapered-driven pins. The connecting rods have forked upper ends and phosphor-bronze boxes at bottom. The pistons are cast iron and flat fitted with double spring rings. Regulation is secured through an inertia governor operating a throttle valve. Three sets ordinarily carry the full load for light and power purposes. There are in all 14 electric motors on board, ten of which are used for driving Sirocco ventilating fans and the remainder in the galley for turning the roasting spickets, dough mixers, etc. Electricity is also used for heating in the first-cabin saloons and state rooms.

BOILERS.

The boilers are placed in two stoke holds and are eight in number, of the double-end Scotch type. There are four boilers in each hold with a large coal bunker between. There is a shallow coal bunker in the forward engine-room bulkhead serving as chute for the coal from bunkers overhead, and a large cross bunker is forward of the boiler room. Each boiler has three furnaces at each end, thus making 48 furnaces in all. Dampers are placed in each smoke box, six to a boiler. Natural draft is used, but in order to carry the air down to the fire room large fans are placed at the top of the fidley grating and drive the air down through chutes on the bunker bulkheads to points about opposite the furnaces. Hydraulic ash ejectors are fitted for removing the ashes. A pipe alley runs from boiler room forward in which are laid various steam and ballast pipes. This also serves as a passage for firemen to their quarters forward.

The boilers are 19 feet 6 inches long and 15 feet 6 inches diameter. The total grate surface is 1,008 square feet, and the heating surface 41,680 square feet.

In each boiler there are 857 tubes, 2 5-8 inches outside diameter by 7 feet 10 inches between sheets; the corrugated furnaces are 48 3-8 inches greatest diameter; the boiler shell is made of 1 19-32-inch plate.

The propellers have three bronze blades; the pitch is 24 feet 6 inches and the diameter 20 feet.

With the addition of the *Baltic*, the White Star line's fleet now consists of thirty-one ocean steamers, with an aggregate tonnage of 360,000 tons. Of these 27 are fitted with twin screws, while 21 are each for 10,000. It is to be hoped that the *Baltic* will be no exception to the list of successful ships operated by this company.

OBITUARY.

It will be learned with regret that Thomas Rowland Western, cashier of the Manufacturers' Advertising Bureau, New York, of which Benjamin R. Western, his father, is the proprietor, died suddenly on May 22, after an illness of only a few days. Mr. Western was of a genial and accommodating disposition and will be missed by many admiring friends.

Practical Points for a Marine Engineer.

BY E. M. PERCY.

Few of the younger engineers of to-day are satisfied with merely a little knowledge of safety valves and stay bolts, sufficient to pass their examinations. There are many things they wish to know, but cannot tell where to find them; not a long, tedious education, but merely some of the practical facts of experience, in figures. For instance, how large should a pipe be? or how many feet of cooling surface should a condenser have?

Not even a handbook is needed, as the more important of these can be given, as here, in a short article.

Beginning with boilers, of the Scotch type, we find the heating surface with natural draft is from 28 to 35 times the grate surface, and from 35 to 48 times for assisted draft, while in water-tube boilers the ratio is higher—in torpedo boats as great as 60 times the grate surface. The heating surface varies in different designs from 2 to 3 square feet per I. H. P., and the I. H. P. per square foot of grate surface varies from 10 in merchant ships to 30 in torpedo boats. The cross-sectional area of stacks and uptakes vary through wide ranges, but without forced or induced draft their area will average one-eighth of the grate surface if correctly proportioned. The amount of water evaporated per hour per I. H. P. for main engines varies from 12 or 14 pounds to 20. For auxiliaries it may run to absurdly wasteful amounts, such as 80 pounds. The coal burned per horse power per hour on an average ship varies from 1 1-2 to 4 pounds per horse power per hour. At 212 degrees Fahrenheit, with clean boiler, as in a test, one pound of coal will evaporate from 9 to 14 pounds of water.

Engineers should particularly note the difference between *stages* of expansions, such as compound, triple, quadruple, etc., and *number* of expansions, which varies from 10 to 20 or more. To get the *number* of expansions take volume of the high-pressure cylinder up to point of cut off and divide it into the total volume of the low-pressure cylinder; the quotient will be the number of expansions. The intermediate cylinders are disregarded, as they are only intermediate expansions.

The area of the ports is calculated from the displacement of the piston times the number of strokes per minute. That is this volume of exhaust steam must be removed through the ports every minute, and the ports are so proportioned that the steam shall attain no higher velocity than 4,000 or 5,000 feet a minute. This gives the ratio: piston speed is to 5,000 as area of cylinder is to X (or area of port). If the ports are properly proportioned for exhaust steam, there will be plenty of area for live steam, which is allowed a velocity of 7,000 to 10,000 feet a minute, depending upon its pressure. This is why the steam ports are never wholly uncovered by the outside lap. The area of the steam pipe is figured in the same way, except that the steam should travel slower than in the ports.

The science of distribution of steam can be best understood by studying a good work on combined cards, such as Holmes or Auchincloss. The cards are taken from the cylinders and then combined on one drawing all to the same scale of volumes and pressures, due allowance being taken of cylinder clearance volumes. This com-

bined diagram then becomes the most valuable of any method for securing proper steam distribution.

One thing that every marine engineer ought to thoroughly familiarize himself with is the table of properties of saturated steam. Here are found at all pressures up to 300 pounds per square inch, the boiling points, latent heat, sensible heat, total heat, volume per pound, weight per cubic foot, and other useful data. If one has the size of a steam pipe and number of expansions he has but to look in his steam tables to get the approximate size of the exhaust pipe, since he has the ratios of volumes, and we know that pressure varies inversely as expansion.

Condensers have from 1 1-4 to 2 square feet of cooling surface per I. H. P. The amount of circulating water and size of pipes necessary is calculated from the latent heat of the steam and the speed of the water through the tubes. The area of the average sea injection and overboard discharge may be placed at an average of one-fourth the total area of the passage through the tubes. The size of the air pump can only be arrived at by complicated calculation, but it averages one-fourth the volumetric displacement of the low-pressure cylinder.

Pumps are chosen with regard to the amount of water they will handle easily. Their piston speed should never exceed 200 feet per minute, and the speed of water through pipes should be less than 500 feet per minute.

Electrical units bother engineers, too. Volts are the measure of the pressure, amperes the measure of quantity. Volts times amperes equals watts; 1,000 watts are termed a kilo watt; 746 watts make a mechanical horse power. On an average there are seven 16-candle-power lamps to a horse power.

For refrigerating machinery we have tables of the properties of saturated ammonia gas, and an engineer cannot do better than study these carefully. Also of carbonic-acid gas, of pictet fluid, and of ether. From the table we get the latent heat of vaporization which is the fundamental principle of refrigeration in any form. Also, it is well to know that for every pound of ice made 142 British thermal units (B. T. U.) of latent heat are given up, for which there is no lowering of temperature, and for every pound of steam made about 1,000 British thermal units of heat are taken up latently, for which there is no rise in temperature. A British thermal unit is the amount of heat required to raise the temperature of one pound of water from 62 to 63 degrees Fahrenheit. A pound of coal when burned gives out 12,000 to 15,000 British thermal units.

Evaporators depend entirely for their principle of operation upon the latent heat of the steam being transmitted to the salt water, to become the latent and sensible heat of its vapor. An evaporator may or may not waste a great deal of heat, according to how it is operated.*

Careful and painstaking engineers are often seen to do ridiculous things because of lack of knowledge on some technical point. Once a chief engineer ordered the electrician to leave the rheostat off and regulate the engine with the throttle, because it took the load off the armature. This is like hanging the weight farther down on the rope because the top was weak.

*See MARINE ENGINEERING, July, 1903, p. 258, for article on "Evaporation," by Mr. Percy.

Another man would slow down his brine pump in hot weather, so that the refrigerating machine could get it colder. He overlooked the fact that it was the rooms, not the brine, that needed cooling. Another engineer would close the auxiliary stop valve until barely cracked, and then, in the face of slowed-down machinery, etc., maintain that the trouble was elsewhere.

Another engineer took out the baffle plate of an already overloaded condenser "so the steam could get around quicker."

Another man carefully lagged the hot pipes from the ammonia compressor to the ammonia condenser "to save the heat," which the next instant was thrown away by the condenser. Another built a drinking-water can around the air chamber of his refrigerating brine pump and then stuffed the space between the pump chamber and the can with asbestos.

These things, while showing industry and ambition, show an ignorance of the common principles of thermodynamics.

Battleship Kentucky's Record Run.

The United States battleship *Kentucky,* with Rear-Admiral Robley D. Evans, recently arrived in New York after three years and seven months in eastern waters, completing a most remarkable cruise. She steamed in all 68,000 miles, and on her homeward voyage from Hongkong she made 12,916 miles, including the slow passage through the Suez canal, in 39 steaming days, or an average of 12.7 knots. This is a record that has not been approached by any other ship of any navy. On her voyage from Southampton to New York the *Kentucky* averaged 13.82 knots, running under natural draft. The *Kearsarge,* a sister ship, and holder of the previous battleship record, made the run a year ago at an average of 13.50 knots, under similar conditions. The *Kentucky* also broke the world's record for rapid and accurate gun firing with her 13- and 8-inch guns, and established a new standard with her 6-inch battery. The ship was everywhere received with great enthusiasm which culminated in the reception at Naples, where, accompanied with the French and Italian squadrons, she took part in the ceremonies attending the visit of president Loubet of France. Later the King of Italy dined on board with the admiral.

Customs in the Panama Canal Zone.—The custom duties of the United States tariff are to be extended to the Panama canal zone, by which all goods entering the zone from foreign countries and for use in constructing the canal must pay the same tariff as if said goods entered the United States.

The Shipping Trust.—As a result of the recent conference of the five voting trustees of the International Mercantile Marine Company, in whose hands the control of the company was placed until 1907, Mr. J. Bruce Ismay is invested with absolute authority of management, and his decision is to be accepted as final. The five trustees are: Mr. J. Pierpont Morgan, the Right Honorable W. J. Pirrie, Mr. J. Bruce Ismay, Mr. Peter A. B. Widner, and Mr. Charles Steel.

BARGES NOS. 94 AND 95, FOR THE STANDARD OIL COMPANY.

There were recently added to the fleet of the Standard Oil Company two of the largest bulk oil-carrying vessels ever built in the United States. These vessels, which will in the future be known by the names of *S. O. Co. 94* and *95*, were built by the Townsend-Downey Shipbuilding Company of Shooter Island, New York city. Because of the great size and carrying capacity of these vessels the accompanying particulars, together with midship section and elevation, will be of special interest.

The specifications called for steel vessels to carry 1,800,000 gallons of oil in bulk, at weight of 7.66 pounds per gallon, and at a draft, when fully equipped for sea, not exceeding 24 feet to bottom of keel. To fulfill these conditions vessels of the following dimensions were designed.

Length, over all	374 ft. 6 in.
Length, between perpendiculars	360 ft. 0 in.
Beam, molded	50 ft. 0 in.
Depth, molded to main deck	21 ft. 0 in.
Depth, molded to spar deck	28 ft. 6 in.
Mean draft, loaded, fully equipped	24 ft. 0 in.
Displacement, at load draft	9,350 tons.

The general arrangement shows a well-proportioned vessel, having a continuous spar deck, with a forecastle about 48 feet in length for housing of towing engine, steam windlass, crew's quarters, store rooms, etc.; a continuous expansion trunk over oil compartments; a steel pilot house, standing above forecastle deck, and a steel house aft for steam-steering gear.

The officers' quarters are located at after end of vessel below spar deck, and are entered by a steel companion just forward of steering-gear house. These quarters are very commodious and most comfortably equipped, the specifications calling for ceilings finished with clear white-pine panels of neat design, sides, doors, berths, Venetian doors, and poles of quartered oak; all rooms furnished with plate-glass mirrors, white enameled iron wash stands with running fresh water, berths with drawers under, desks, chairs, settees with leather cushions, etc., and the floor to be covered with inlaid linoleum. The officers' lavatory is fitted out with white tiled floor, large porcelain-lined bath tub connected up for salt or fresh water, and a flushing water closet.

The crew's quarters, in forecastle, are finished in white pine and fitted out with three white enameled iron wash basins with running water, Lein-Irvine white enameled iron berths for eight men, and lockers for each man.

The pilot house, above forecastle deck, lighted by nine 24-inch diameter, extra-heavy brass lights, is finished inside in quartered white oak, with a floor of walnut and maple laid in narrow strips, and is fitted out with brass steering standard and hard-wood wheel, binnacle and compass, flag locker, desk, settee with leather cushions, etc.

The vessels are rigged with five steel masts, stepped on top of expansion tank, and extending 80 feet above spar deck. The foremast is 32 inches diameter at bottom and 27 inches at head, and arranged to act as a smoke stack for boiler, and the spanker mast 26 inches diameter at foot and 15 inches at top, and arranged to act as smoke stack from galley. Each mast is furnished with gaffs and booms for carrying sail, and care has been taken that all rigging is of ample strength. Shrouds and stays are of the best steel-wire rope, galvanized, and running rigging of best manila, with all blocks of the best five-roller bearing pattern.

Sails are hoisted by a Williamson 7- by 7-inch hoisting engine located on top of expansion trunk just forward of mizzen mast, leading sheaves being placed at bottom of each mast for this purpose. For towing purposes a patent towing chock is located at stem head and a 16- by 16-inch, No. 5 steam towing engine under forecastle deck, arranged for 3,000 feet of 6-inch circumference towing hawser of special make, having 37 wires to the strand. There are also supplied a 12-inch manila hawser of 90 fathoms, warps, and lines, as required by Lloyd's Register of Shipping for a vessel of this size.

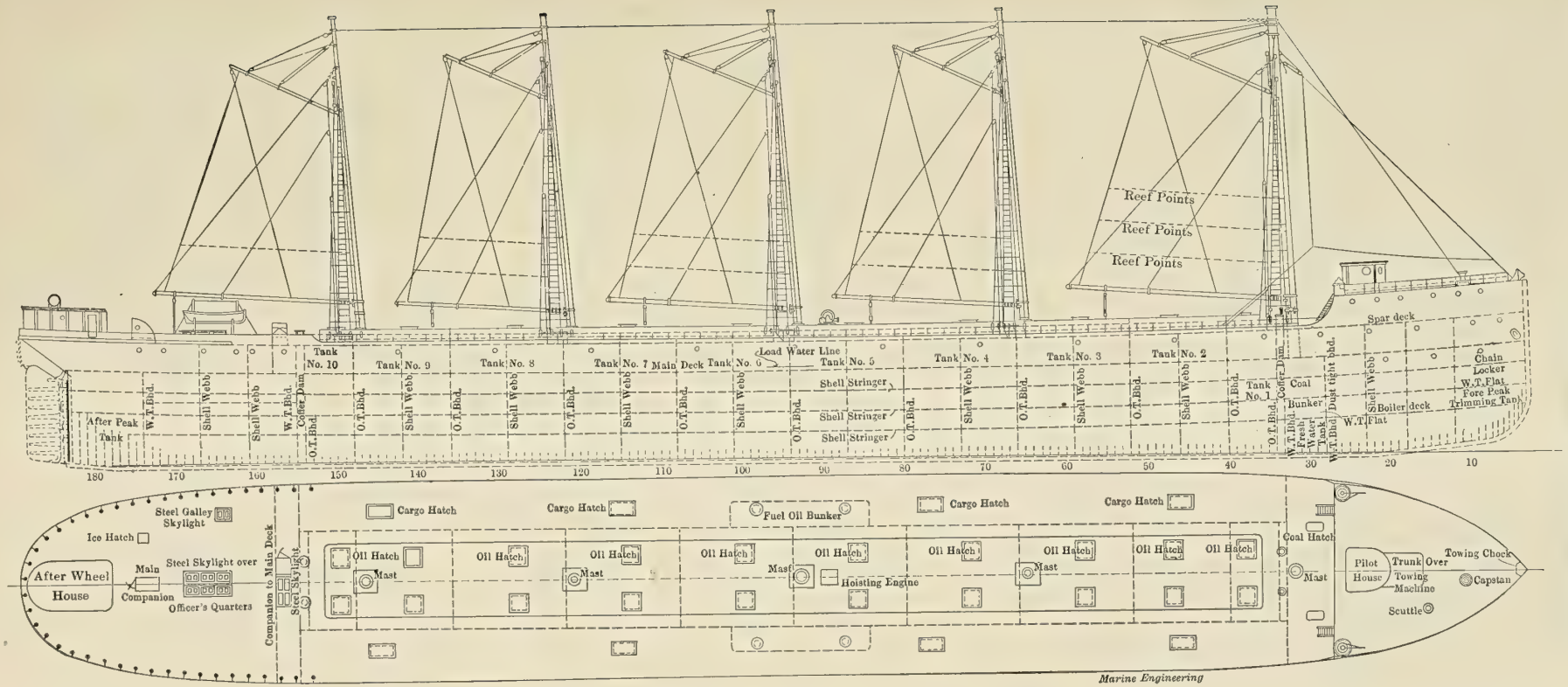
The windlass is located forward of towing engine, with a capstan standing above forecastle deck, and is of the Hyde pattern, with 12- by 12-inch vertical engines. An independent docking capstan is located aft on spar deck on starboard side of wheel house. Steering is done by a 7- by 7-inch Williamson steam and hand gear, with a brass standard and hard-wood wheel in forward pilot house for steering by steam, and a wheel in after house for both hand and steam.

The generating set, located in the boiler room forward, consists of a General Electric Company's single vertical engine, enclosed type, capable of running plant with full load at steam pressure of 80 pounds, but designed for a full working pressure of 125 pounds, connected on same bed plate with a 6-pole, 7-Kw. direct-current Westinghouse. The generator is a standard compound-wound machine having a capacity of 64 amperes at 110 volts. Separate wires are run without break from dynamos to an automatic indicator in pilot house, and from indicator to the port and starboard running lights, which are arranged for the use of either oil or electricity, and located in towers standing above forecastle deck.

Special care has been taken with the sanitary arrangements and steam heating of these vessels, all plumbing being of the latest style. A large fresh-water tank, of about 4,000-gallons capacity, is located at after end of main deck and gravity tanks on top of wheel house and pilot house, for supplying all wash basins, galley, water closets, baths, etc., with running fresh water. These tanks each have a steam pipe, controlled with valve, running through them, to prevent freezing of water in cold weather. In addition to the foregoing, a large fresh-water tank is built into vessel below coal bunker to hold 30,000 gallons, mainly for use of boiler.

The boiler room and coal bunkers are located at forward end of vessel, the bunkers having a capacity of about 100 tons of coal, and constructed absolutely oil tight, so that, by closing up of bunker doors, they may be used for oil fuel instead of coal, if so desired.

The boiler is of the Scotch type with two Morison suspension furnaces, and is 11 feet 6 inches in diameter by 11 feet 6 inches long, with 198 3-inch tubes, and constructed to work at a pressure of 120 pounds. The heating surface is 1,610 square feet and grate surface of 45 square feet. Located also in the boiler room is a 14- and 10- by 12-inch fire pump, a 5 1-4- and 3 1-2- by



DECK PLAN AND LONGITUDINAL OF ONE OF THE NEW STANDARD OIL BARGES.

6-inch feed pump, connected to draw from sea and fresh water; a Wheeler condenser having cooling surface of 500 square feet, and a Korting injector.

In the pump room, which is located at after end of vessel, are two oil pumps, size 18 and 14 by 24 inches, with 10-inch suctions and 8-inch discharges, a 5-foot blower for blowing gasses out of pipes, and a bilge pump 10 and 8 by 12 inches, the bilge and fire pumps being arranged as suction or discharge from any compartment, sea and deck.

The oil mains are 10 inches in diameter, one each side of center-line bulkhead, having two suctions from each tank. The main steam line is a 3 1-2-inch wrought-iron pipe, run between decks, and supplies steam to galley sink, radiators, three connections to spar deck, and all pumps.

As shown on the midship-section drawing, opposite the first page of this issue of MARINE ENGINEERING, special attention has been given to building the barges of sufficient strength and oil tightness to meet all the requirements of Lloyd's Register, in which the vessels are classed. It is especially worthy of note that these two ships are the largest merchant vessels ever built in New York city.

OIL ENGINES.

BY H. B. MAXWELL.

To Brayton, of this country, is, in all probability, due the credit of producing the first motor to use the heavier grades of petroleum. This motor was built in 1872, and only intended for stationary service. It was built to use the heat generated by burning the petroleum at constant pressure, and required auxiliary air and oil pumps, which consumed so large a portion of the indicated horse power that the mechanical efficiency was very low.

About 1888, Etèvé's patent was purchased by Priestman, who began the manufacture of the Priestman oil engine under this patent. This motor has a special spraying nozzle which sprays common kerosene oil into a retort heated by the exhaust gases from the cylinder; The retort is heated by a torch for starting. Fig. 1 gives a view of this device including the novel vaporizing jet. There is a recepticle for oil in the base of the engine and the eccentric, which operates the exhaust valve, also actuates an air pump which pumps air into the oil tank from which oil and air pipes run to their respective parts of the vaporizer jet. As the mixture from this jet is too rich to be effective there is an auxiliary air inlet controlled by a throttle connected to the same stem as the oil throttle, and both are operated by the governor. Ignition is by jump spark having both poles of the secondary circuit insulated and contained in one metallic plug which screws into the combustion chamber.

Right here the writer wishes to call attention to a vital point in gas or oil-motor design, a point that aids materially in getting the best results both in mechanical efficiency and fuel economy; it consists of putting the inlet and exhaust valves through the cylinder head, as per Fig. 2. This was later exploited by Buchet, of France, on air-cooled motors for cycles and light automobiles. In this country it was first used by the author on stationary motors, in 1895, and recently was adopted by John Wilkinson, of Franklin air-cooled motor fame, for automobile motors.

This is without doubt the most effective position for the valves, as the wall surface in the combustion space is reduced to a minimum and there are no ports or chambers to retard combustion; furthermore, the valve has an effective opening all around its circumference, which is not the case when placed in a chamber at the side of the cylinder proper. While it is somewhat difficult to operate the valves when placed in the cylinder heads, this arrangement will be more and more used as designers realize the advantages to be gained.

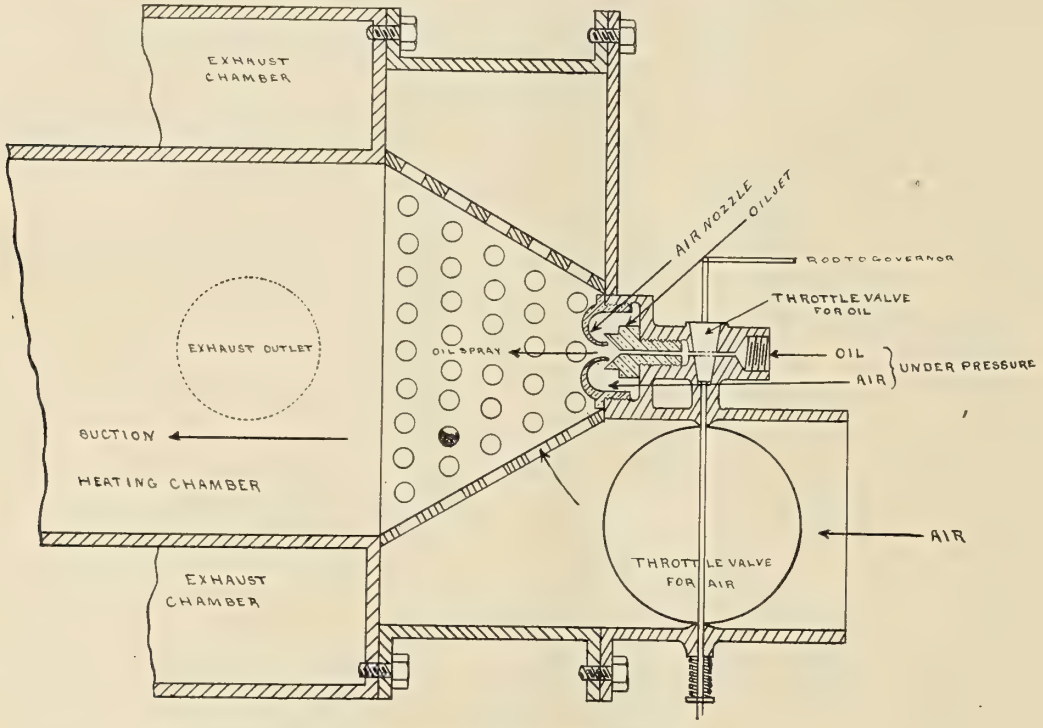


FIG. 1.—PRIESTMAN OIL ENGINE.

Next we have the Hornsby-Akroyd oil engine, which is entirely different from the Priestman, inasmuch as the oil is pumped into an unjacketed extension to the cylinder, as per Fig. 3. The oil vapor in the retort is too rich to explode until the piston returns and compresses the pure air, taken in on the suction stroke, into the retort, where it forms an explosive mixture and ignites from the heated walls of the retort at the proper time. This motor works best at nearly constant load, as at light loads the heat of the retort will diminish, resulting in uncertain ignition.

This engine, in modified form, is made in the east, while in the two-cycle style it is made on the Pacific coast under the name of the Hot Ball engine, and used for marine work. As the oil of the Pacific coast region

has an asphaltum base, this engine does not work as well as it would with Pennsylvania petroleum, owing to the asphaltum gumming up the piston rings and ports. There is one firm on the coast that makes a vaporizer for kerosene or crude oil, which can be used with any

drawn into the cylinder, and at near the end of the compression stroke the oil is forced into the cylinder by means of an air jet from the high-pressure reservoir; it is there ignited by the heat of compression, and holds up the pressure for a portion of the power stroke. There

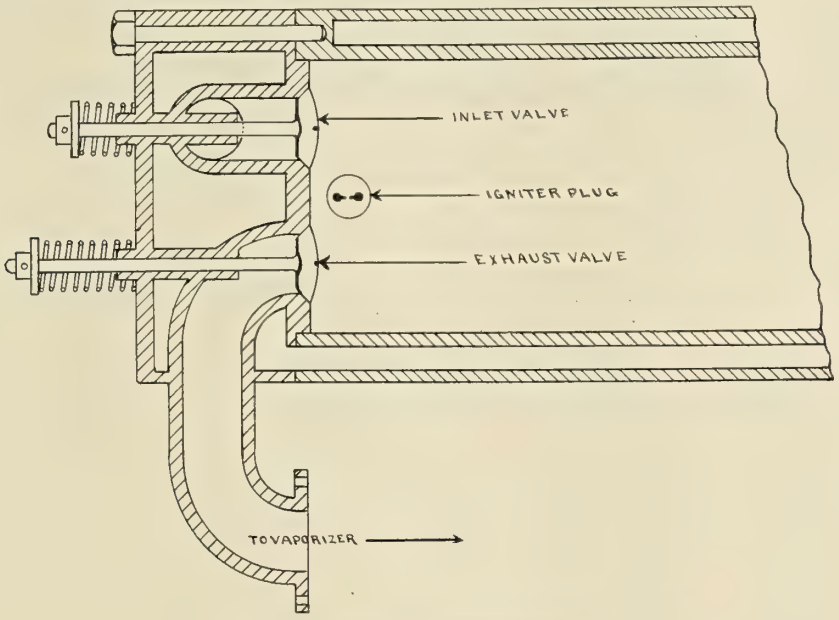


FIG. 2.—VALVES IN CYLINDER HEAD.

engine, and avoids this difficulty, and while the writer has never seen this device he believes from reports at hand that it is a success. It is adapted to either two- or four-cycle motors.

The Diesel oil motor is one that can be used for boat

is no explosion, as in other types of engines, and the oil supply being under control of the governor the oil used is proportional to the work done. An indicator card taken from this motor shows very plainly the point of cut-off of the fuel for various loads.

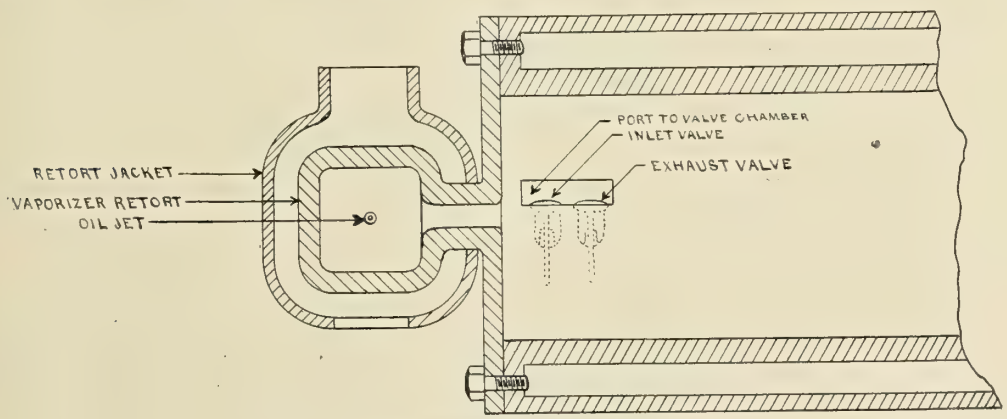


FIG. 3.—HORNSBY-AKROYD OIL ENGINE.

propulsion. In this motor high economy is claimed, and the claim is well founded. Extremely high compression is used, upwards of 500 pounds per square inch; the heat of compression is the only means of ignition. This motor requires an air pump for maintaining a pressure in the oil reservoir somewhat higher than the compression in the power cylinder. The motor operates on the four-cycle principle; on the suction stroke pure air is

In the Secor oil motor ordinary compression occurs; in the first engines the jump spark form of ignition was used, but later this was abandoned for a hammer-break sparker. The main feature of this motor is the manner of feeding the fuel; both oil and air valves are controlled by the governor but are capable of independent adjustment. By referring to Fig. 4 it will be seen that oil regulating valve and the air valve *J* are linked to-

gether and both are controlled by the governor lever *I* through the cranks *G, E, C,* and connecting rod *B*. *A* is a short lever with spring stop pin to engage in holes in disc *D* for oil-valve adjustment, the fine adjustment being made through slot in crank arm *C*. In the oil reservoir, which is of the constant level type, the kerosene oil is carried at a level of about one inch higher than the oil jet opening in the suction pipe. *K* shows a cup for holding gasoline, which is used for starting the motor, the needle valve *H* controlling the outlet into suction pipe. This motor gives good results and is well adapted for marine use.

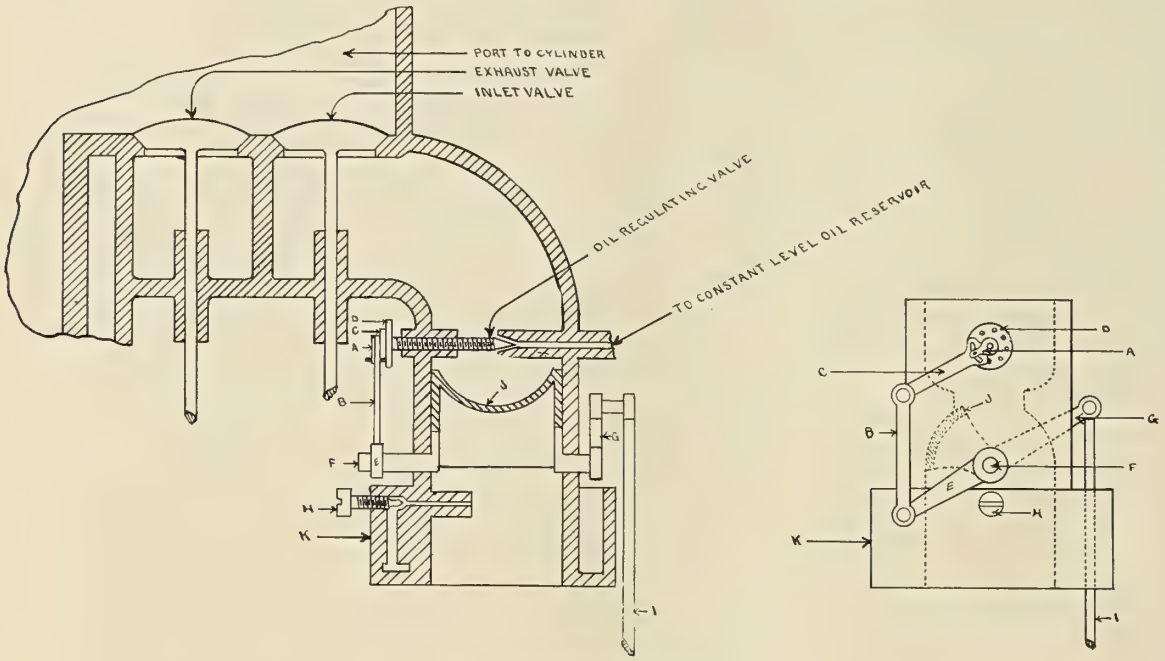


FIG. 4.—THE DIESEL OIL MOTOR.

The Metz and Weiss motor is of the two-cycle type, in which the oil is fed by a pump and injected into the cylinder at a point near the combustion chamber onto the plates *E, E, E,* shown in Fig. 5. The said plates are cast integral with the head; for starting the head is heated by a torch.

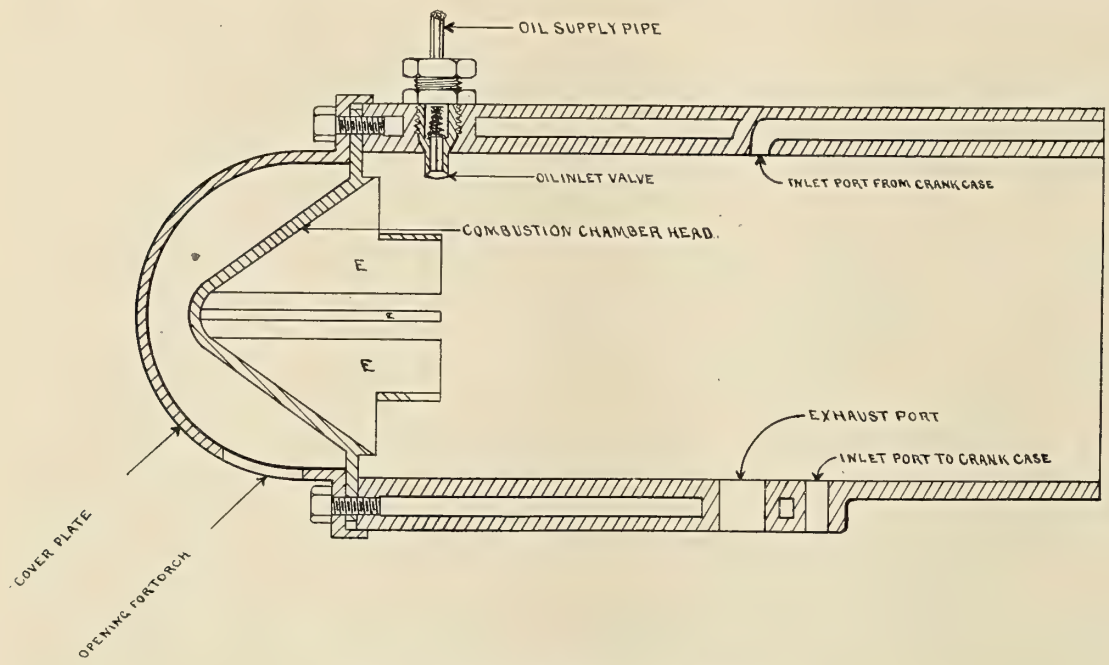


FIG. 5.—MIETZ & WEISS TWO-CYCLE OIL ENGINE.

The engine invented by Mr. H. G. Underwood possesses unique features, chief of which is the system of ignition. It is a two-cycle motor and has a small piston on the end of the main piston working in a cylinder cast on the head. In this cylinder the compression is high enough to ignite the charge, and the resulting flame is conveyed through a small outlet to the main combustion chamber and there ignites the main charge. This is a first-class motor for marine work. The main points are shown in Fig. 6. The oil is claimed to be fed by gravity or air pressure; the former is not practical unless a check valve is used to prevent the crank case compression forcing the oil back into the reservoir.

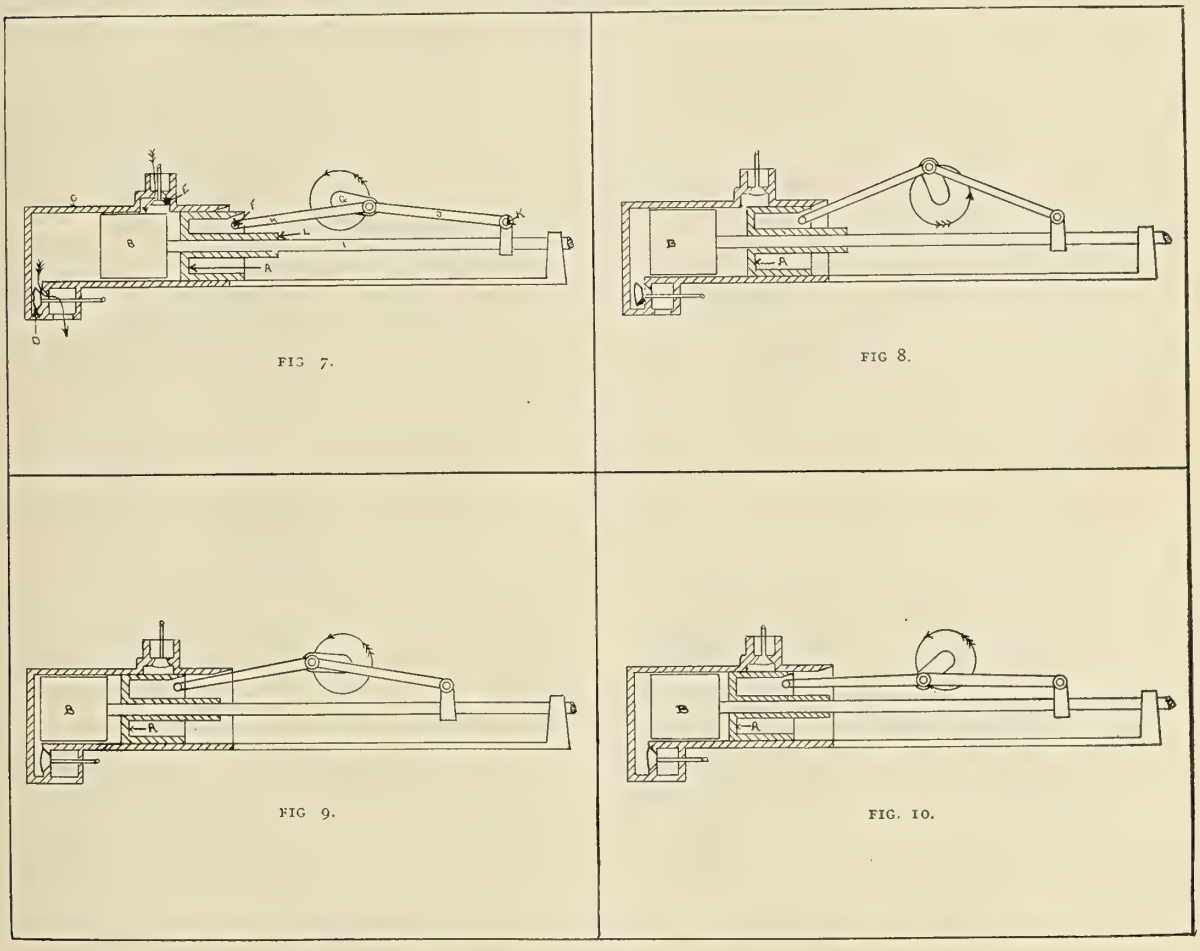


FIG 7.

FIG 8.

FIG 9.

FIG. 10.

TWO-CYCLE, OPEN-END CYLINDER MOTOR.

Probably the most novel oil motor is one illustrated in Fig. 7, and built in Chicago. It is a two-cycle motor with open-end cylinder and open crank case. By referring to the figure *C* is the cylinder, *A* the main piston, *B* an auxiliary piston having a check ring at the head end which allows the gases from between the pistons to escape to the combustion chamber. *B* is supported on rod *I* in the bearing in *A*. G is the crank to which are connected the rods *H* and *J*. *K* is the connection for rod *J* to rod *I*.; *F* is piston pin in *A* to which rod *H* is connected; *D* is the exhaust valve, mechanically operated, and *E* is an automatic inlet valve. Fig. 7 shows the beginning of the exhaust and suction strokes, the piston *B* moving toward the head of cylinder forces out the products of combustion and aspirates a fresh charge between the pistons *B* and *A* through the inlet valve *E*. Fig. 8 shows the beginning of the compression, *A* moving toward *B*, and forcing the charge by *B* into the combustion chamber. Fig. 9 shows completion of compression and the ignition point which is caused by the hot unjacketed cylinder head. Fig. 10 shows the power stroke under way. The head of motor is heated by a torch to start the motor. This engine will run as a hot-air motor by keeping the torch burning, but to get good power a mixture of gas and kerosene oil and air is fed to induction valve *E*. A double cylinder, 4 1-2 by 4 1-2, gives 5 brake horse power at 500 revolutions.

Last we will consider a kerosene motor that is a first-class solution of the problem of using the heavier grades of petroleum. It is a two-cycle motor possessing practically all of the advantages and none of the disadvantages of the Diesel motor. This motor is the invention of Mr. Oscar P. Ostergren, who was the first to produce liquid air in commercial quantities. It is designed to be made with two or more cylinders; Fig. 11 shows a section of the cylinder parallel with the crank shaft, while Fig. 12 a section at right angle thereto.

It is made with a cross-head similar to steam engine construction and uses the lower part of the cylinder for compressing a charge of pure air to about 7 or 8 pounds per square inch. The action is as follows, starting with

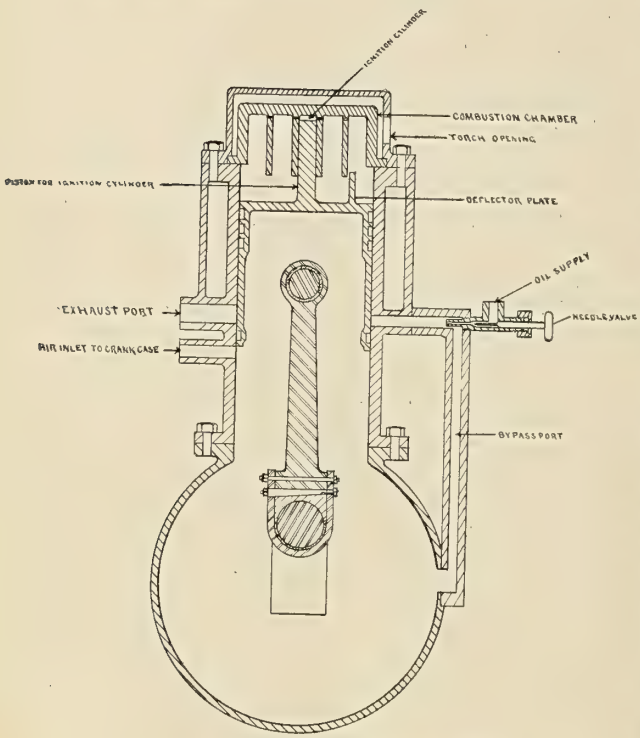


FIG. 6.—THE UNDERWOOD OIL ENGINE.

the piston down: As the piston rises air is admitted through the poppet valve *D* to the lower end of the cylinder; on descending, when the ports are as in Fig. 12, the air enters under the cap plate *C, C,* and is projected toward the top of the cylinder forcing the products of combustion of the previous charge out into exhaust chamber *G, G.* As the piston rises, part of the charge is admitted by ports *L* above and below the piston valve *M,* which is operated by a cam; when the piston is at the top, the plate *C, C,* closes the port *L,* and the piston *M* continues to rise and forces air through *Q* into *K,* and with the oil from *U* through *S* and *T* into the combustion chamber, where it is ignited on coming into contact with the hot cap *C, C.* Mixing with the heated air, when the piston descends, part of the charge escapes through valve *N* and port *R* to a reservoir in which the pressure is much higher than the compression pressure in the cylinder proper. This reservoir is used to feed the oil through the coil in the exhaust pipe *V,* shown in Fig. 12. The motor is governed by valve *I,* shown in Fig. 12, acting on the oil supply; in case the pressure in the cylinder should rise higher than the pressure in *Q* and *U,* the valve *J* seats itself. The compression pressure is about 200 pounds per square inch.

This article presents a few of the main types of the various oil engines, and, the writer thinks, covers the ground, for, while there are many different makes, they can be classified under some one of the types shown.

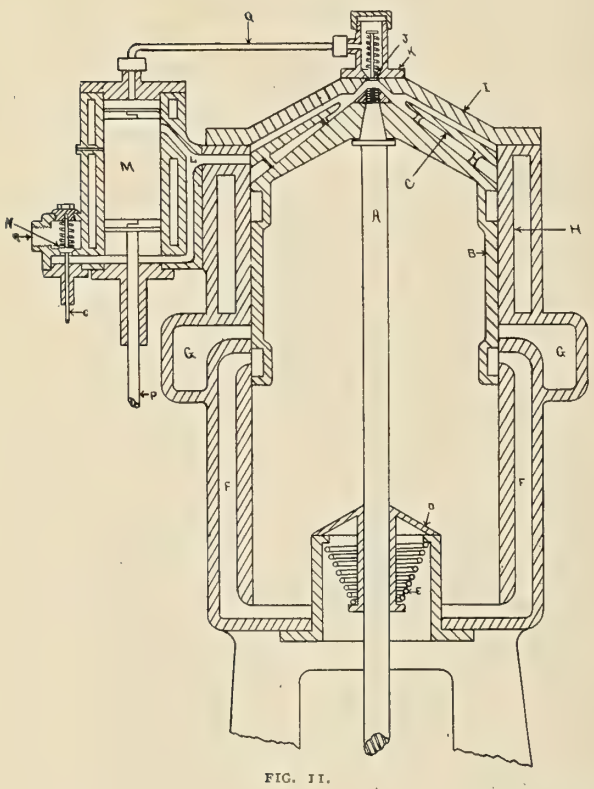


FIG. 11.

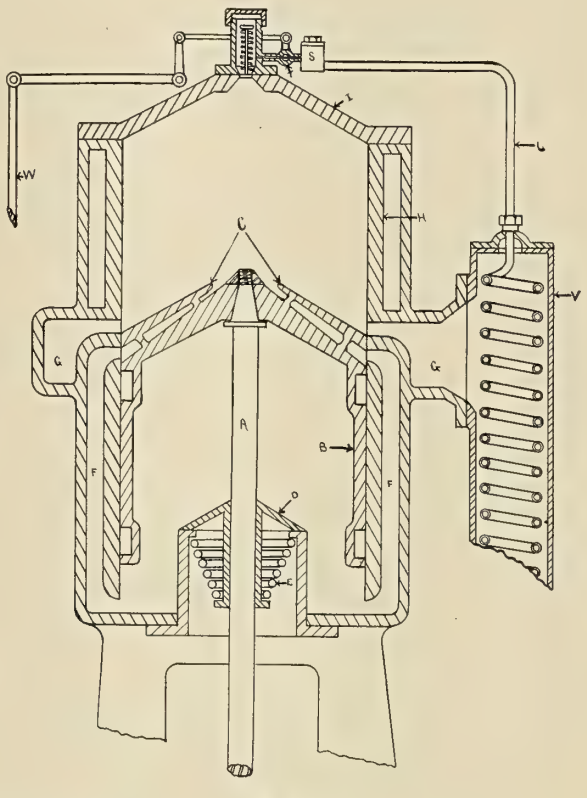


FIG. 12.

THE OSTERGREN KEROSENE MOTOR.

BREAKING UP THE OLD NEW BEDFORD WHALER ROUSSEAU.

The Passing of the New Bedford Whalers.

Fifty or so years ago the fleet of vessels sailing from New Bedford comprized three hundred or more sails. This fleet has steadily diminished until scarcely one of the old vessels is left. They were built "on honor," the timbers being heavy and of white oak, and the planking to correspond. They were all copper fastened, and whenever one of these whalers is put out of commission because of the cadence of the whaling industry, she is broken up and burned for the copper. Many a vessel has been found to contain from $2,000 to $3,000 worth of this metal. The illustration herewith shows the bark *Rousseau,* which was one of the most famous of the entire whaling fleet in the value of her voyages. One of the very last voyages made by a whaler was very profitable, as she brought home, in addition to a good cargo of sperm oil, about $20,000 worth of ambergris.

Ice-Breakers and Their Services.

At a recent meeting of the Institute of Marine Engineers, London, a paper was read by Mr. A. Gulston on "Ice Breakers and Their Services." In part he said that ice-breakers were of many forms and dimensions, varying from a steam launch of 40 feet to the immense ship *Ermack,* 8,000 tons displacement and 10,000 I. H. P. In 1870 appeared the first recognized ice-breaker, the tug *Pilot,* of Kronstadt, with specially-built bow. In '99 this boat was superseded by two small ice-breakers, *Zarja* and *Luna* of 150 I. H. P. each. These boats are used for towing purposes in the open season. The ports of Hamburg and Copenhagen followed the lead of Kronstadt, and at Hamburg there are now several ice-breakers. Although these vessels are not large, they were well designed and suitably arranged for the work they had to perform amongst the drift ice in the Elbe. The first ice-breaker at Copenhagen was the *Staerkodder,* of 800 I. H. P.; but the fine ice-breaker *Sleipner,* belonging to the harbor authorities, now controlled the winter traffic at Copenhagen. That vessel was of 2,000 I. H. P. and 1,450 tons displacement. The *Sampo* in the Gulf of Finland passed through field ice of 12 to 16 inches in thickness at 8 knots, and the thickness of the drift ice she had generally been at work in was some 8 feet to 10 feet, through which she could pass at from two to three knots.

Ordinary merchant steamers trading during the winter in ice-bound seas should have the plating at the bows doubled, and the side plating for some width above the water-line should be of a much heavier scantling than usual. The propeller blades should be of very strong design, and so fitted to the boss as to facilitate repairs. When that was done steamers could, to a large extent, take care of themselves.

At Reval there were four ice-breakers of varying dimensions, and the efforts of those vessels were supplemented by a well-arranged system of telegraphing all ships approaching the coast. There were also ice-breakers at Odessa, Kiel, Riga, Stockholm, Roscoff, Stettin, Libau, Amsterdam, Calmar, and Nicotisk, Vladivostock, &c.

The speaker then took up the design of ice-breakers and vessels suitable for working amongst ice. Those vessels, he said, should have the bow angles and lines so arranged that when they mounted the ice, and the ice was giving way under the vessel's weight, they would not jamb when returning to be water-borne forward, always remembering that they were advancing and should remount the ice. An ice-breaker should also be able easily to turn out of the channel she had cut, and the form of the bow lines had much effect on that manœuvre. The designs of ice-breakers varied so much that there was no certain data to guide builders, but practice had shown that the full forward form, or spoon-shaped bow, was not successful in hard and packed ice, as the vessel pushed the ice in front of herself, instead of cutting and dispersing it. Additional stringers, stronger decks, and a liberal addition to the number of bulkheads, transverse and longitudinal as well as many pillars, became a necessity to prevent the constant recurrence of repairs. All piping should be kept under the deck, and the fire pipes should be fitted with hydrants below and above that deck. The boiler-rooms must be well closed up, and consideration had to be given to the disposal of the ashes. The rudder should be arranged for easy unshipment afloat, and should be of large area and immensely strong. The moving parts of the machinery and the shafts must be extra strong and largely in excess of ordinary practice. On the engines it was preferable to have direct steam reversing gear, as the "all-round" type was a very heavy tax on the engineers when the ship was ice-breaking. The vessel should be so designed that, if possible, she could be tipped to replace a propeller blade whilst afloat.

The speaker then proceeded to describe the ice-breaking passenger and mail steamers. There were, he said, not many of those vessels at work, and they were not able to force the packs so readily as an ice-breaker could. Three vessels of that type, the *Express* and the *Åbo,* running between Stockholm and Hango, and the *Bore,* running between Stockholm and Abo, kept up a steady time-table throughout the winter. After referring to various vessels of that type, the lecturer described the *Stanley,* an ice-breaking mail boat belonging to the Canadian Government, and engaged in running between Prince Edward's island and Newfoundland. The *Britannia*—the first steamer of the Cunard Company—was next dealt with. That vessel, Mr. Gulston observed, became imprisoned in the ice at Boston, Mass., in 1844, and the people of the town arranged to help to cut her out. That project was carried through by sawing and breaking the ice, and by the aid of her paddle-wheels she reached the open water. The distance that the *Britannia* had to be cut out was seven miles, and at that date that was a remarkable undertaking.

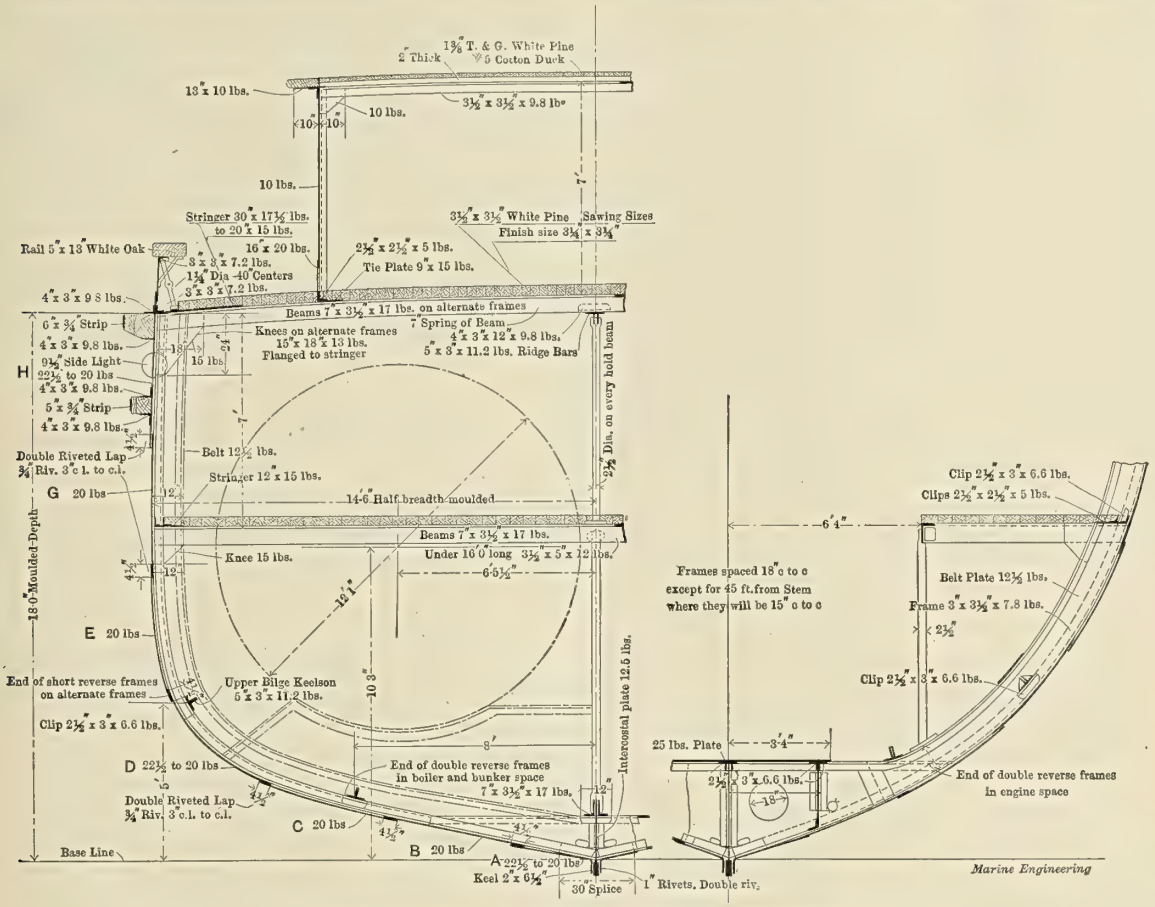
Another type of vessel for use in winter was the railway ferry ice-breaking steamer. Some of these vessels were of great size, and those best known were used on the Danish State Railways, between the islands of the Great Belt and the mainlands. There were also the famous railway ferry ice-breakers at Saratoff, on the River Volga. As those two steamers had to pass through the system of locks on the Marinsky canal from Lake Ladoga to the River Sweir, and so to the Volga, it had been necessary to build them so that they could be parted to enter the locks—the ice-breaker in halves and the railway ferry into four portions. The next described was the *Scotia,* also built at Walker-on-Tyne. She had been constructed to the order of the Inter-Colonial Railway, of Canada, for service across the Strait of Canso, between Cape Breton island and Nova Scotia. She was a typical ice-breaker. Either end of the vessel was intended to be bow or stern at will, so that in working it was not necessary for her to turn round when entering or leaving her landings. On her deck she had three sets of rails, and was designed to carry nine Pullman or corridor bogie sleeping cars 80 feet long, each weighing 52 tons unloaded. The lecturer then described the railway ferry ice-breaking steamers *St. Marie* and *St. Ignace,* which plied across the Straits of Mackinaw, between Lake Huron and Michigan, a distance of seven miles. Both those boats were built of oak, sheathed with iron in way of the water-line.

After describing yet other vessels of the same type for use in American waters, Mr. Gulston proceeded to give a detailed account of the building and working of the famous ice-breaker *Baikal,* running on Lake Baikal, in the centre of Siberia. The vessel was built to connect the eastern and western ends of the Siberian Railway, which, as they knew, made a continuous railway from Ostend to Vladivostock in Eastern Siberia and Port Arthur in Manchuria. The distance of the ferry across the lake was fifty-two miles. The *Baikal* was built on the Tyne. The hull was completely erected, marked, taken down and shipped inside of six months, and 2,700 tons weight in 6,900 packages had to be transshipped for some 1,500 miles across Siberia by boat to the place of re-erection. The boilers, of which there were fifteen, had to be kept under 20 tons in weight for trans-shipment purposes. The next vessel to be considered was the *Ermack,* which had been built for Polar enterprise, as well as for ice-breaking in the Baltic. The speed of the *Ermack* through 24 inches of solid ice, with 6 to 12 inches of snow on it, was 9 knots, and she could charge and demolish packs of ice 20 to 23 feet thick. In Polar ice the speed had to be kept at about from 2 1-2 to 3 1-2 knots. She had proved herself to be of enormous use on her station on the Baltic coast of Russia, where she could negotiate any ice and could safely bring out of danger all steamers that she went to assist. Indeed, in one season she rescued and assisted shipping of over £2,000,000 value, and in another winter she salved the Russian battleship *Grand Admiral Aprixine,* of £750,000 value. With the *Ermack* in the Baltic there was no difficulty in Russia putting her fleet to sea, which usually wintered at Kronstadt, as the *Ermack* could easily guide them to open water should necessity arise, and there was nothing to prevent that vessel herself being made into an armored cruiser.

Ocean-Going Steel Tug Conestoga.

Towing coal in barges along the coast has required an increasing fleet of barges and tug boats. The Philadelphia and Reading Railroad Company, which owns many a craft of this kind, has recently had built at the yards of the Maryland Steel Company the tug *Conestoga*, much similar in size and design to other large sea-going tugs of this company's fleet. These tugs are under steam, with but short intermissions, for months at a time. As soon as they bring one tow of barges into port another one for the return trip is assembled and the tug boat starts out to sea with only a few hours' delay for coaling and taking on provisions and stores.

The *Conestoga* is heavily built throughout, being in


1⅜" T. & G. White Pine
2" Thick
⅝ Cotton Duck
13"x 10 lbs.
3½"x 3½"x 9.8 lbs.
10 lbs.
10 lbs.
Stringer 30"x 17½ lbs. to 20"x 15 lbs.
3½"x 3½" White Pine Sawing Sizes
Finish size 3¼"x 3¼"
Rail 5"x 13" White Oak
16"x 20 lbs.
2½"x 2½"x 5 lbs.
Tie Plate 9"x 15 lbs.
3"x 3"x 7.2 lbs.
1¼" Dia. 40" Centers
3"x 3"x 7.2 lbs.
4"x 3"x 9.8 lbs.
Beams 7"x 3½"x 17 lbs. on alternate frames
6"x ¾" Strip
4"x 3"x 9.8 lbs.
Knees on alternate frames 15"x 18"x 13 lbs. Flanged to stringer
7" Spring of Beam
4"x 3"x 12"x 9.8 lbs.
5"x 3"x 11.2 lbs. Ridge Bars
9½" Side Light
22½ to 20 lbs
4"x 3"x 9.8 lbs.
5"x ¾" Strip
4"x 3"x 9.8 lbs.
Belt 12½ lbs.
Double Riveted Lap ¾" Riv. 3" c. l. to c. l.
Stringer 12"x 15 lbs.
G 20 lbs
14'-6" Half breadth moulded
Beams 7"x 3½"x 17 lbs.
Under 16'0" long 3½"x 5"x 12 lbs.
Knee 15 lbs.
6'-5½"
12'1"
18'0" Moulded Depth
E 20 lbs
End of short reverse frames on alternate frames
Upper Bilge Keelson 5"x 3"x 11.2 lbs.
10'3"
Clip 2½"x 3"x 6.6 lbs.
8'
D 22½ to 20 lbs
End of double reverse frames in boiler and bunker space
7"x 3½"x 17 lbs.
Intercostal plate 12.5 lbs.
Double Riveted Lap ¾" Riv. 3" c. l. to c. l.
C 20 lbs
B 20 lbs
A 22½ to 20 lbs
Base Line
Keel 2"x 6½"
30" Splice
1" Rivets, Double riv.
2½" Dia. on every hold beam
Clip 2½"x 3"x 6.6 lbs.
Clips 2½"x 2½"x 5 lbs.
6'4"
Frames spaced 18" c to c except for 45 ft. from Stem where they will be 15" c to c
Belt Plate 12½ lbs.
Frame 3"x 3½"x 7.8 lbs.
2½"
Clip 2½"x 3"x 6.6 lbs.
25 lbs. Plate
3'4"
2½"x 3"x 6.6 lbs.
18"
End of double reverse frames in engine space
Marine Engineering

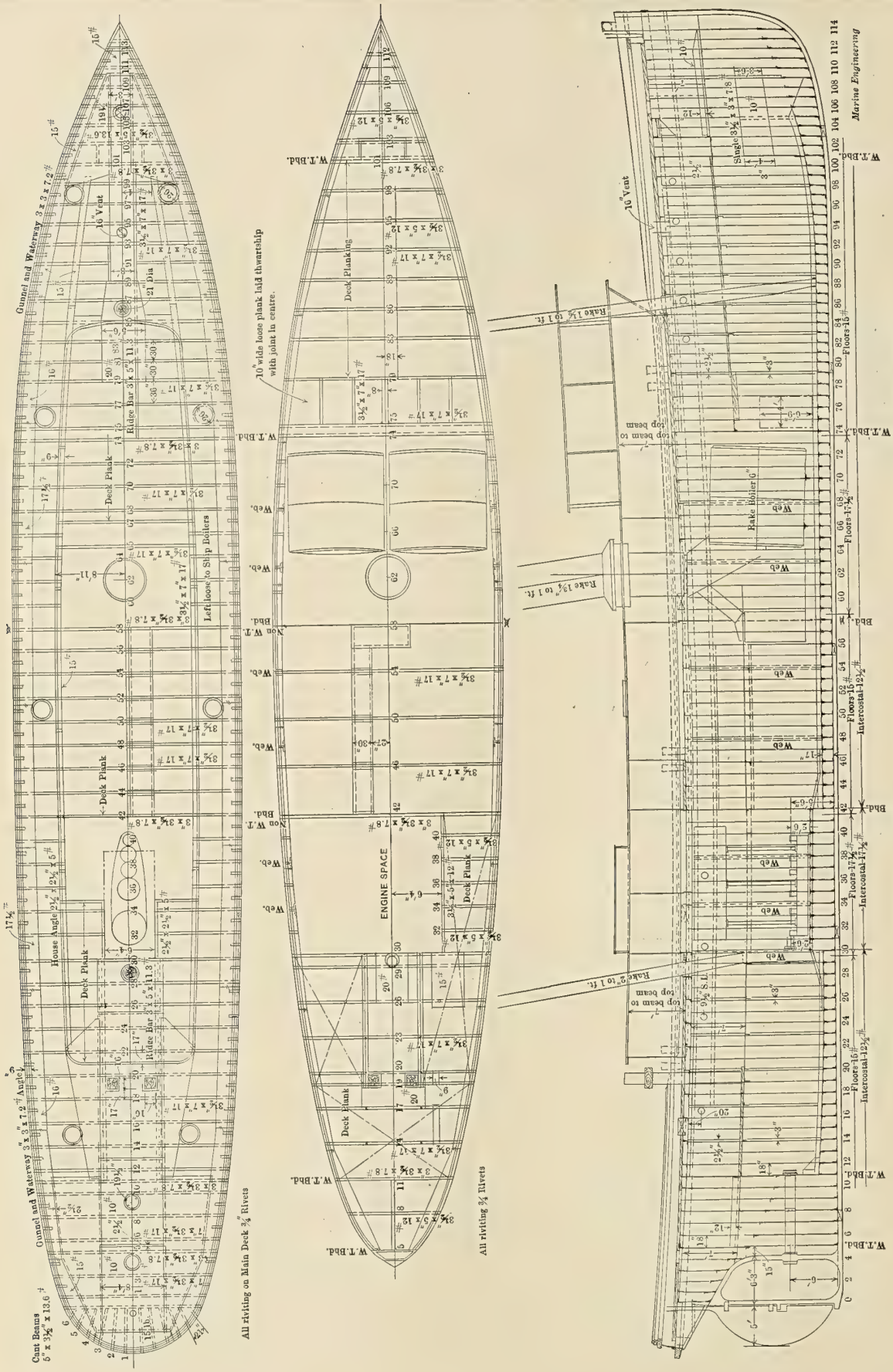
MIDSHIP SECTION OF THE OCEAN-GOING STEEL TUG CONESTOGA.

MARINE ENGINEERING DATA CARD. **AUGUST, 1904.**

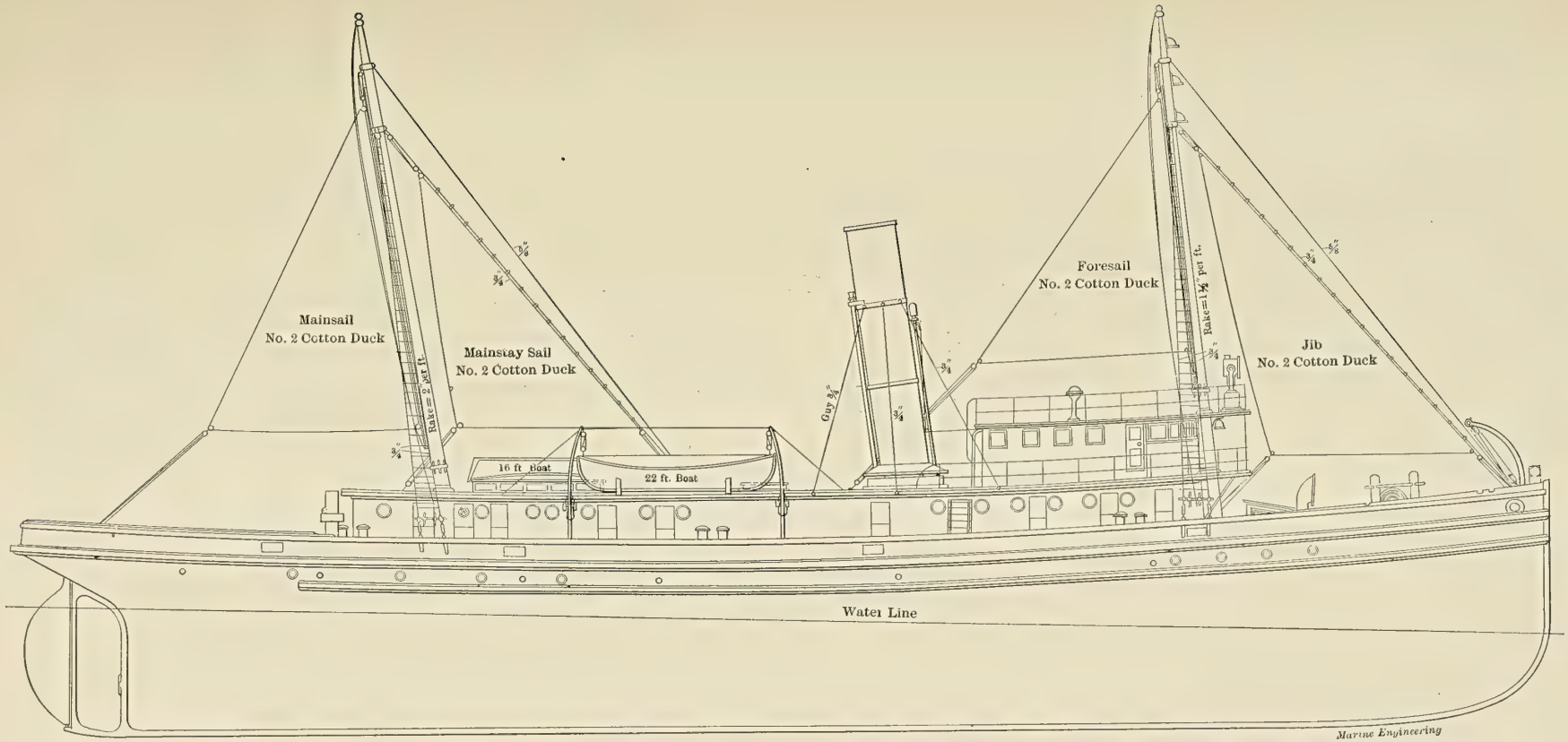
NAME—Conestoga. NATIONALITY—American. TYPE—Ocean tug.

LAUNCHED—1904. BUILDERS—Maryland Steel Co. OWNERS—Philadelphia and Reading R. R. Co.

Length over all	170 ft. 0 ins.
" between perps	163 " 6 "
Beam, molded	29 " 0 "
Depth at side	18 " 0 "
Load draft	14 " 0 "
Trial "	11 " 3 1-2 "
Displacement, load	950 tons
" trial draft	590 "
Tonnage, gross	612
" net	420
Engines: Number	one 3-cylinder triple expansion
Cylinder diameters	18, 28 and 45 ins.
Stroke	30 ins.
Shaft, crank diameter	9 "
" tail "	9 1-8 "
Condens. built in	1,588 sq. ft.
Circulat. pump, suction diameter	9 ins.
" " engine	7 by 7 "
I. H. P.	1,000
Propellers: Diameter	11 ft.
Pitch	13 "
Area	50 sq. ft.
Boilers: Number	two Scotch
Diameter	12 ft.
Length	12 ft. 6 ins.
Working pressure	170 lbs.
Furnaces: Number	three
Diameter	35 ins.
Tubes, diameter	3 "
	Common combustion chamber.
G. S. two boilers	113.7 sq. ft.
H. S. " "	3,168 " "
Donkey boiler	46 ins diameter by 7 ft. height



DECK PLANS AND LONGITUDINAL OF THE OCEAN-GOING TUG CONESTOGA, BUILT BY THE MARYLAND STEEL COMPANY.

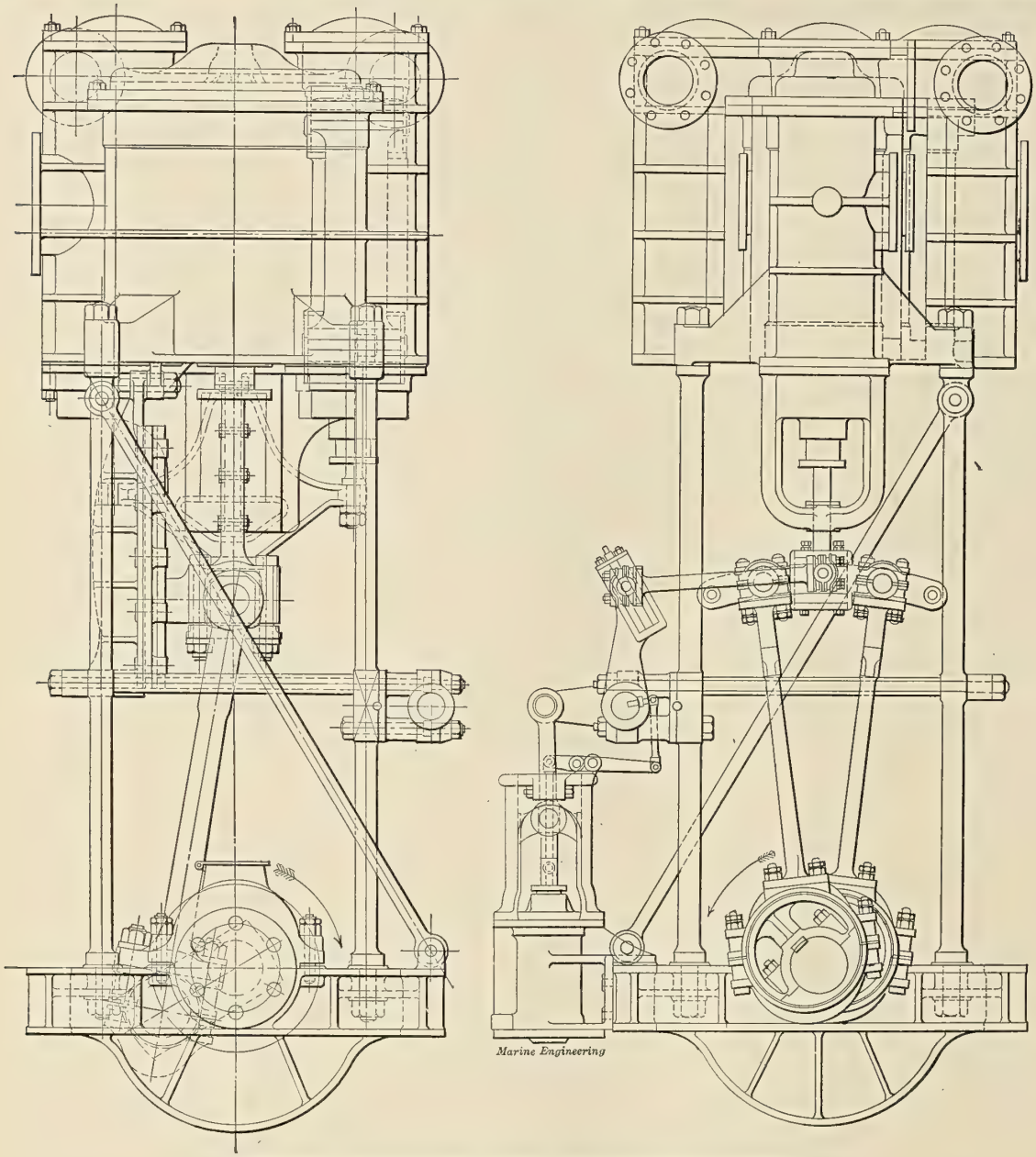


SAIL PLAN OF THE OCEAN-GOING TUG CONESTOGA.

excess of the classification of the American Bureau of Shipping. The general character of the boat is plain and substantial, specially fitted for heavy work. The scantlings are given in the midship section on page 365, while the general arrangement is shown in the deck plans and longitudinal on page 366. The hull is divided by four water-tight bulkheads to the main deck, as shown in the longitudinal. The lower deck is worked in forward of the boiler room and aft of the engine-room space. The crew have accommodations forward on the lower deck, and in the large deck house are the dining room, galley, and toilet rooms. In this deck house are also the officers' quarters, and on top is a large pilot house with captain's room.

The equipment of the deck machinery is heavy throughout and consists of one steam gypsy with a 5 by 8-inch double engine of the Hyde make, a Hyde windlass for 1 1-4-inch chain and fitted with bitts, and a Williamson steam-steering engine 4 1-2 by 4 1-2-inch double cylinders. A large towing machine for a 1 5-8-inch wire hawser is placed in the aft end of deck house. Very heavy towing bitts are fitted, as shown on the deck plan aft. Large coal bunkers are provided midships. Fresh water is carried in the peak tanks forward and aft.

The engine is triple expansion, with cylinders 18, 28, and 45 inches diameter by 30 inches stroke, to develop about 1,000 horse power. The full equipment of independent pumps for fire, feed, sanitary, and wrecking purposes is installed, while the air, bilge, and feed pumps are direct connected to the main engine. Two large Scotch boilers furnish steam at 170 pounds pressure. Each is fitted with three Morison furnaces 35 inches diameter, entering into a common combustion chamber. The vessel is electric-lighted throughout by current from one 80-ampere and one 40-ampere machine. Other particulars will be found in the data card.



HIGH-SPEED, TRIPLE-EXPANSION ENGINE FOR AN AUXILIARY SCHOONER.

Low-Pressure Cylinder, Looking Forward. Scale: 3-4 Inch = 1 Foot. High-Pressure Cylinder, Looking Aft.

Auxiliary Engine of a Three-Masted Schooner.

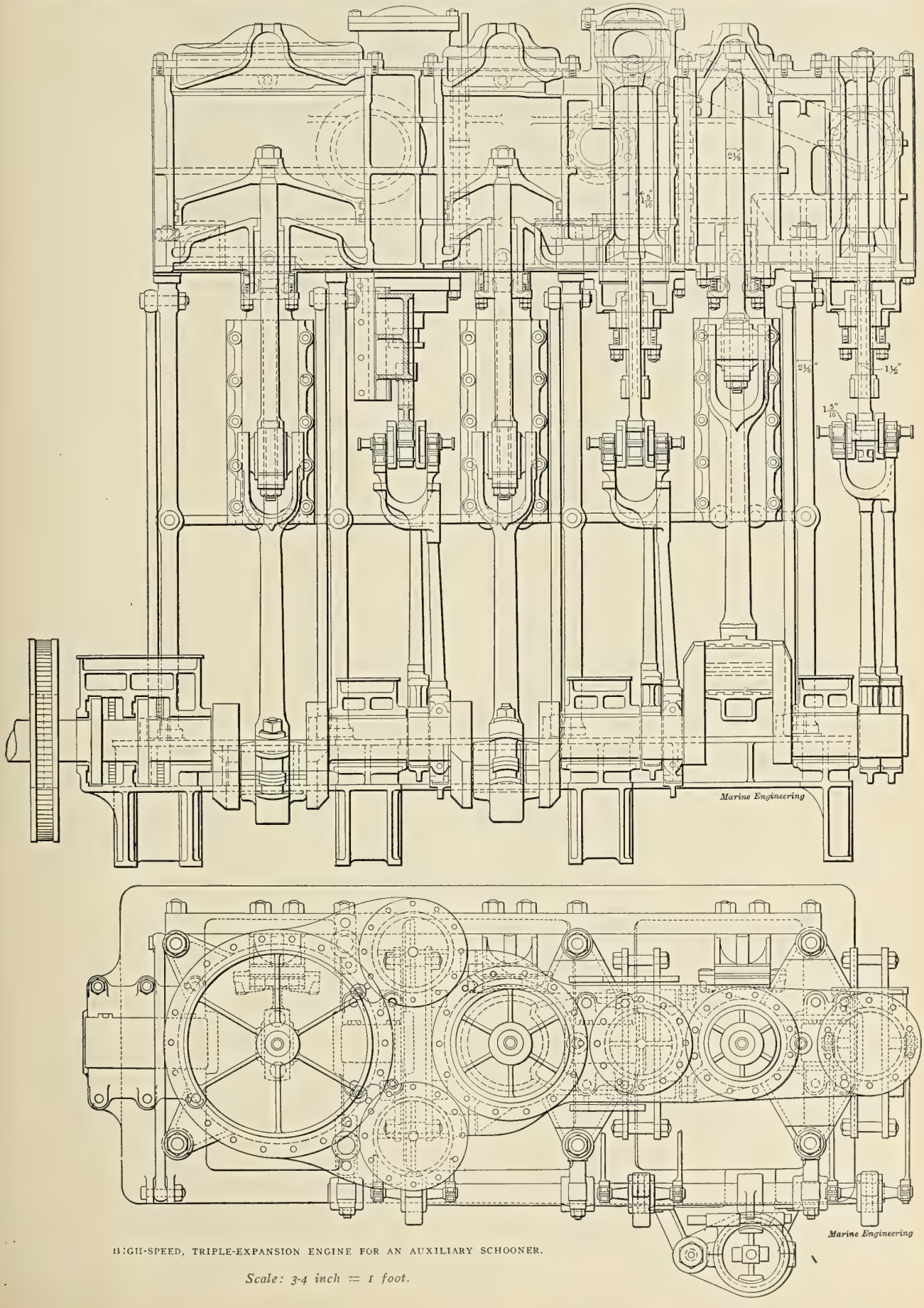
This engine is of the triple-expansion type with diameters of cylinders 9, 14, and 22 1-2 inches, having a common stroke of 16 inches, running at 235 revolutions. The engine is designed to indicate about 400 horse power with a boiler pressure of 250 pounds per square inch. The arrangement of the cylinders and valves is as follows:

High-pressure piston valve, high-pressure cylinder, intermediate-pressure piston valve, intermediate-pressure cylinder, low-pressure piston valves, low-pressure cylinder.

Each cylinder and valve chest are made in one casting of close-grained cast iron, and piston valves are fitted with cast iron liners. They are provided with relief valves, drain cocks, indicator cocks, etc., lagged with magnesia, and covered with Russia sheet iron with brass strips. The cylinder covers have coverings of pressed sheet brass and are turned bright like the piston valve covers. The cylinders are supported at the front and back by eight wrought steel columns turned bright, with diagonal braces, and they are held together by machine bolts, as shown in the drawing.

The entire bedplate is made in one piece of cast iron and has four cross joints providing journals and thrust bearings. The main bearing caps are of cast iron, the bottom bushes are of brass, both lined with white metal.

The pistons are of cast iron, dished type, and fitted with two open piston rings. The piston rods, of wrought steel, are 2 1-8 inches in diameter. Both piston rod and



HIGH-SPEED, TRIPLE-EXPANSION ENGINE FOR AN AUXILIARY SCHOONER.

Scale: 3-4 inch = 1 foot.

valve-stem stuffing boxes are of brass and fitted with Katzenstein's metallic packing.

Piston rods and slipper crossheads are forged in one piece. Crosshead guides, being of cast iron, have two brass guides for astern going, and are bolted with one side to the cylinders, with the other side to a wrought-steel bar, which connects all back columns.

The connecting rods, which are 38 inches between centers, are 3 inches diameter at crank end, and 2 7-16 inches at fork end.

Crank ends have brass boxes lined with white metal 4 7-8 inches in diameter by 8 inches long, while crosshead ends are solid joint with the crosshead pins, which are 3 inches in diameter by 4 7-8 length.

The high-pressure cylinder has one piston valve of 6 1-2 inches diameter, the intermediate-pressure cylinder has one piston valve 7 1-2 inches diameter, and the low pressure has two piston valves of 8 1-2 inches diameter each. All valves take steam on the outside and have a common stroke of 4 inches. The valve-stem guide brackets are cast on the bottom valve-chest covers, and the low-pressure valve-stem guide brass crosshead runs in cast iron guides, which are made in halves, each half part cast on the bottom of one of the low-pressure valve-chest covers.

The valve-stem guides are fitted with hard composition boxes, in halves, held in place by set screws. All valve stems are of wrought steel, with the lower end forged large enough for composition boxes, which are made in halves. The diameter of valve-stems at guide and stuffing boxes are 1 1-2 inches reduced to 1 5-16 inches where they pass through the valves.

The link blocks are of open-hearth steel, annealed after forging, and finished all over. They have at each end a pair of jaws to span the corresponding bar of the link. The jaws are fitted with brass gibs, finished to the curve of the links, and have tap bolts for adjustment. The diameter of pin is 2 7-16 inches with 1 5-16 axial hole.

Each reversing link is suspended from the corresponding arm on the reversing shaft by suspension links, with ends fitted with brass bushes made in halves. The reversing shaft is 2 5-8 inches in diameter with cast-steel arms; reversing arms are arranged for linking in and out. The eccentric rods are of wrought steel; each rod has a T head secured to its eccentric straps by two studs. The upper end of each rod is forked to span the links and fitted with composition bearings.

The eccentric straps are of brass. Each strap is lined with white metal fitted into dovetailed recesses and hammered in place. The eccentrics are made in two parts, the larger part of cast iron and the smaller part of forged steel. The reversing gear consists of a direct-acting steam cylinder controlled by the usual floating levers.

The crank shaft is forged in one piece and the sequence of cranks is as usual, namely: high, intermediate and low. The thrust bearing is built according to standard construction and is fitted on astern-going side with white metal.

The main feature of this engine is the very closed arrangement and light yet strong construction; valve chests carried out on top and bottom, thence giving straight and large steam ports, and roller thrust bearing.

ENGINE DATA.

Engine 9, 14 and 22 1-2 inches by 16 inches
R. P. M. 235 pounds.
Boiler pressure 250 pounds.
Connecting rod, length, 38 inches.
Valves, piston, one on H. P, one on I. P., two on L. P.
Diameter 6 1-2, 7 1 2 and 8 1-2 inches.
Travel 4 inches.
Steam taken on outside.
Eccentric rod, length, 34 inches.

Cylinders.	H. P. and I. P.		L. P.	
	Top	Bottom.	Top.	Bottom.
Width of port, ins.	1 1/4	1 1/4	1 3/4	1 3/4
Steam lap. ins	1 1/16	1 1/16	1	5/8
Exhaust lap, ins	5/16 neg.	3/32 pos.	1/8 neg.	5/16 pos.
Angular advance, degrees	33	33	38	38
Steam lead, angular, "	6	7 1/2	9 1/2	10 1/2
" " linear, ins	11/64	15/64	17/64	5/16
Cut-off, ins	12 8	11.52	11.96	10.6
Per cent. stroke	.80	.72	.7475	.663
Release, ins	14.44	14.56	14.470	14.62
Per cent. stroke	.9025	.91	904	.914
Compression, ins	96	1.152	1.87	1.968
Per cent. stroke	0.060	0.072	117	.123
Steam opening, ins	1 1/16	1 3/16	1	1 1/8
Exhaust opening	Full	Port	Full	Port.

The Merchant Marine in the Political Platforms.

The platforms adopted by the republican and democratic national conventions contain clauses on the merchant marine each of which is expressed in no uncertain language. That adopted by the democrats is as follows:

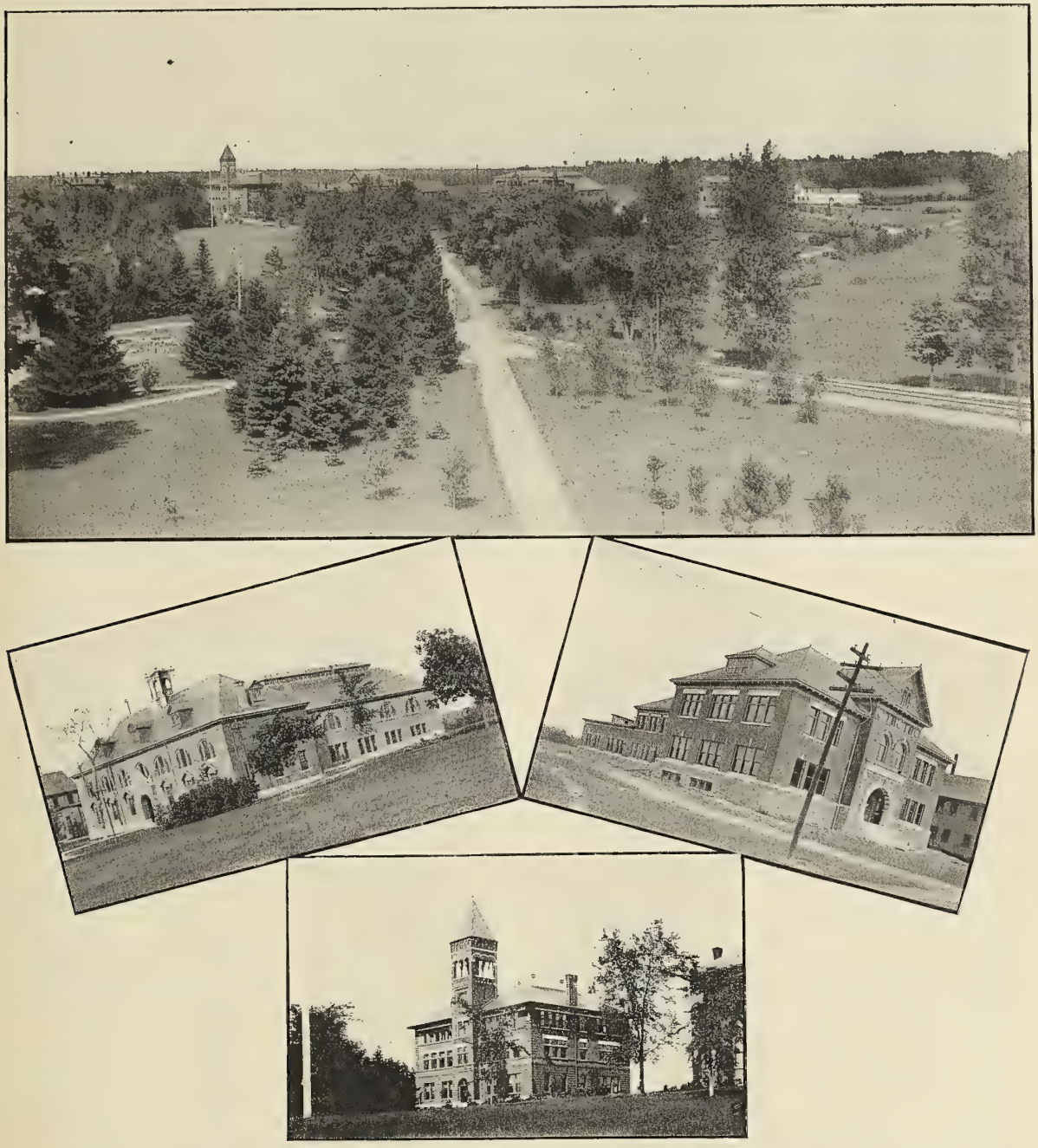
"We denounce the ship subsidy bill recently passed by the United States Senate as an iniquitous appropriation of public funds for private purposes, and a wasteful, illogical, and a useless attempt to overcome by subsidy the obstructions raised by republican legislation to the growth and development of American commerce on the sea.

"We favor the upbuilding of a merchant marine without new or additional burdens upon the people and without bounties from the public treasury."

The republican platform is as strongly in favor of subsidy as the democratic is opposed to it. The platform also contains a statement of a naval policy to be adopted. On this question the democratic platform is silent.

"While every other industry has prospered under the fostering aid of republican legislation, American shipping engaged in foreign trade in competition with the low cost of construction, low wages, and heavy subsidies of foreign governments has not for many years rereceived from the government of the United States adequate encouragement of any kind. We therefore favor legislation which will encourage and build up the American mercantile marine, and we cordially approve the legislation of the last congress which created the Merchant Marine Commission to investigate and report upon this subject.

"A navy powerful enough to defend the United States against any attack, to uphold the Monroe Doctrine, and watch over our commerce is essential to the safety and welfare of the American people. To maintain such a navy is the fixed policy of the republican party."



GENERAL VIEW OF CAMPUS, UNIVERSITY OF MAINE.

Alumni Hall, Containing Executive Offices, Drill Hall, and Gymnasium. *Lord Hall, the New Engineering Building.*
Wingate Hall. Civil Engineering, Drawing, and Physics.

MECHANICAL AND MARINE ENGINEERING COURSES AT THE UNIVERSITY OF MAINE.

In 1862, while the nation was enagged in the most bitter struggle in its history, there was enacted by Congress an act which was destined to become the most potent single factor in the educational interests of the country. This was the Land Grant Act, a measure prepared and twice pushed through Congress by the Hon. Justin S. Morrill, of Vermont, and finally signed by President Lincoln, which provided for the granting of public lands for the permanent endowment of colleges in all of the states that would accept the bequest and guarantee to provide the material equipment with which to carry on the work, the chief object being to teach the sciences relating to agriculture and the mechanic arts. As the direct result of this measure there exist to-day in the United States nearly half a hundred universities and colleges, in each of which the sciences above mentioned form an all-important part when not the exclusive feature of the established curriculum. Nearly every state now has its technical school, in which its youth is being instructed in the useful arts, and every

year nearly ten thousand young men are being sent from them into the wealth-producing industries to do their share in the development of the country's resources. In every year that passes there is being manifested by our leading business men an increased confidence in these trained men, and a dependence upon them to furnish the energy and enterprise to bring our industries to the front; and so marked has been our advancement, during recent years, that already English capitalists and educators are studying our educational systems with a view to the improvement of their own.

Maine was one of the earliest states to accept the conditions of the grant, and, in 1868, the institution was opened under the name of the Maine State College of Agriculture and the Mechanic Arts. This name was changed to the University of Maine, in 1897, to correspond with the broader scope of the work that had been decided upon. The policy of the trustees, as upheld by the state, has been to make the university the fitting head of the educational system of the state, in which respect it resembles the great state universities of the west more closely than do the corresponding institutions in other sections of New England. In accordance with this idea the university now includes the College of Liberal Arts, with three distinct courses; the College of Agriculture, with four courses; the College of Technology, with four courses, namely: civil, mechanical and electrical engineering, and technical chemistry; the College of Pharmacy, with two courses; and the College of Law. In the College of Liberal Arts it is possible for the student to specialize in the Greek, Latin, German, or French language, mathematics, civics, history, philosophy, biology, physics, or chemistry, which, with the more closely prescribed courses in the technical and professional schools, allows great freedom in the selection of subjects and gives ample opportunity for every one to find the line of work best suited to his tastes and abilities.

For admission to all courses leading to degrees, excepting in the College of Law, the candidate must offer credits to the extent of 26 points, or their equivalent, one entire year's work of five recitation exercises per week in the preparatory school on a given subject counting two points. Candidates for the College of Technology must include the following: English, 4 points; algebra, 4 points; plane geometry, 2 points; solid geometry, 1 point; one modern language, 4 points; one science, 2 points; history, 2 points. The remaining points may be taken in additional language, mathematics, science, history, or civics. Certificates for the satisfactory completion of this work are accepted from such fitting schools as are approved by the New England College Entrance Certificate Board. Credit is given for work done at other colleges, and students coming from such institutions are given such advanced standing as the work taken entitles them to receive.

Students not candidates for degrees, who wish to take up special work along any line, are allowed to do so on presenting satisfactory evidence that they are fitted to do the work with profit to themselves. Men of experience in engineering work, who desire more thorough grounding in mathematics and the theoretical side of engineering, are welcomed and assisted in every way possible.

The college year of thirty-six weeks is divided into two equal portions or semesters. A subject in which recitations are held once each week, continued during one semester, counts one term hour. In counting laboratory, shop, and drafting-room work two hours of actual time are counted as one. Five term hours count as one credit, and thirty credits, or 150 term hours, are required for graduation in the engineering courses.

The college year begins on the Thursday nearest September 20, this being September 22 in 1904. Short vacations during the Christmas holidays and at Easter are allowed, which bring commencement early in June, and give a long summer vacation.

In arranging his course of study the student is allowed the greatest possible freedom, the elective system being in use. In the engineering work it is of course necessary that the different subjects be taken up in a fixed order, and every student is also required to take two credits in each of the following subjects: English, modern language, mathematics, and some one science. These conditions practically prescribe the work during the first two years, but during the last two considerable opportunity for selection is afforded.

In the mechanical engineering course an option in marine engineering has been offered during the last two years, giving the student an opportunity to specialize in his steam engineering work on the marine types of machinery and their application to ship propulsion. The work of the course, with the necessary allied subjects, is laid out as follows:

During the first two years the study of mathematics, English, modern language, chemistry, and physics occupies by far the greater portion of the time. During these years, however, nine term hours are completed in general drawing and descriptive goemetry, three term hours in mechanisms, and four in shop practice.

In the third year the engineering work consists of mechanics of engineering, machine design and the steam engine valve gear, electrical machinery, one term hour in mechanical laboratory, and eight term hours in shop practice. During the second semester of this year, work in the marine option begins. Each student lays down the preliminary lines of some type of ship, after which he performs the simpler calculations for displacement and center of buoyancy. The purpose of this is to give him that familiarity with the forms of ships, methods of laying off sections, etc., that the designing marine engineer should possess.

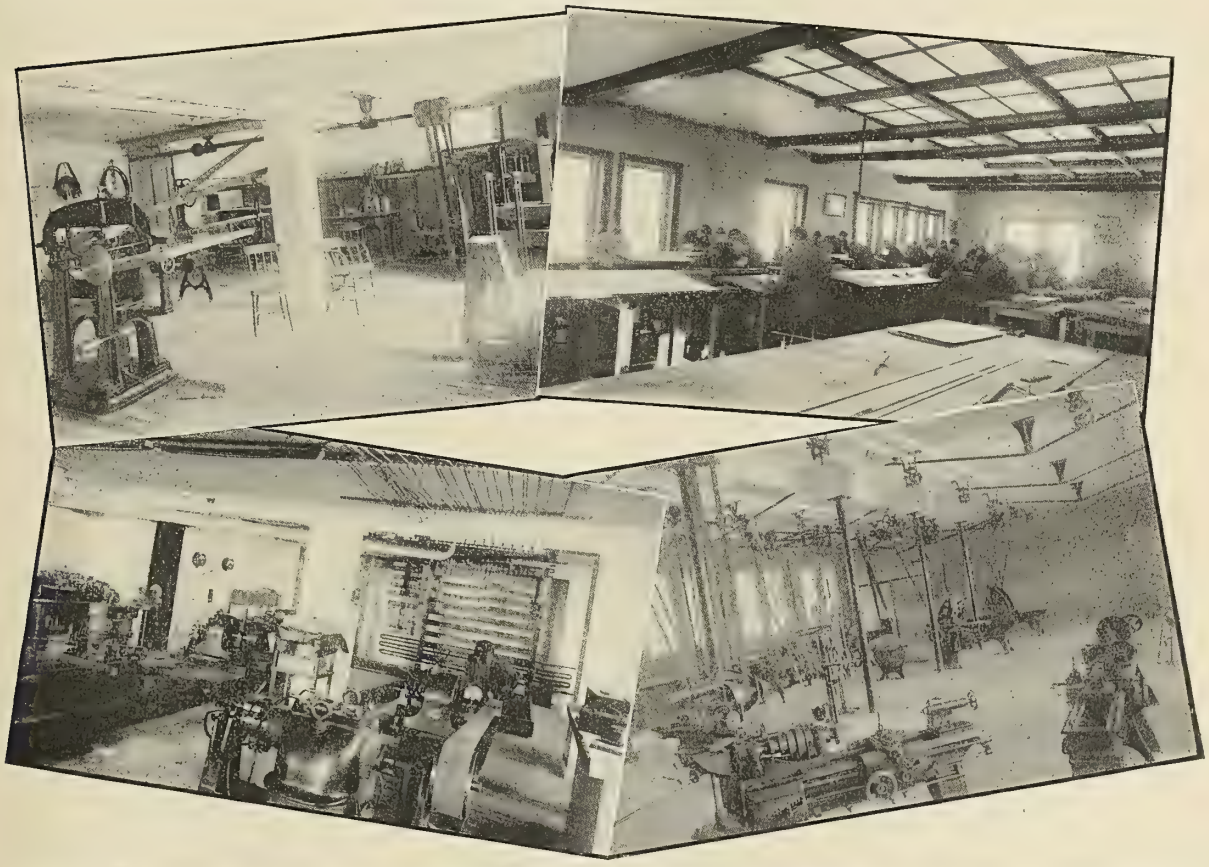
The fourth year's work in the regular mechanical engineering course includes thirteen term hours in steam engineering, of which about one-half is devoted to drafting-room work on boilers and engines, two term hours on materials of engineering, three in mechanical laboratory, two each in hydraulic machinery and in building construction, and three is allowed for thesis work, although that amount is usually exceeded. The work of the marine option differs from this in substituting marine for hydraulic machinery, and ship propulsion for building construction, while the designs of steam machinery are taken for theses, thus increasing the time devoted to steam engineering. Existing types of marine boilers and engines are carefully studied, and working drawings made for a Scotch return tubular boiler and for some type of multiple expansion engine.

A model of the Stephenson link is used in the design of the valve gear. In ship propulsion especial attention is given to power calculations by the law of comparison, and to propeller design by the most approved methods.

Careful attention is given to current engineering literature and to library work generally, and frequent meetings are held for discussion of topics of interest arising in this way. It is believed that the formation of reading habits and the arousing of an interest in subjects of general importance are among the most valuable features of a college course.

At present particular attention is being given to the development of mechanical laboratory work, for which, in the past, facilities have been lacking. A new building for the use of the departments of mechanical and electrical engineering has recently been erected, and is now being equipped. Accompanying cuts show this building in exterior and interior views. The first floor and half of the basement in the front portion, which is 56 by 82 feet, is to be devoted to laboratory purposes, one-half of the first floor for electrical work, and the remainder for mechanical and hydraulic work. On the second floor are the offices, recitation room, and a large drafting room for the two departments. In the rear wing are located the work shops. On the ground floor are the machine shop, 40 by 65 feet; the forge shop, 40 by 31 feet; and the foundry, 40 by 26 feet. Above the machine shop is the wood-working shop. In the machine shop, for which a moderately extensive equipment of first-class machines is already owned, the Hyatt Roller Bearing Company's shaft bearings are to be used in part, and a special feature of the arrangement is to be the adaptability for testing for power losses in transmission and power to drive machine tools. All the machinery is to be motor driven, on the group system, the General Electric Company's motors being used. The B. F. Sturtevant Company, of Boston, is to furnish the new down-draft forges for the forge shop, as also the heating and ventilating system for the entire building.

The mechanical laboratory, on the first floor of the main building, is divided into two rooms, one of which has a solid floor of earth filling covered with a six-inch layer of Portland concrete, and this again by four inches of plank flooring. In this room are to be placed a 60,000-pound Riehlé Brothers standard testing machine, a torsion testing machine, and a friction machine for testing lubricating oils. Room for additional machines in the future is ample. In the second and larger room, which will be the general headquarters for the experimental work and a portion of which will be held for lecture purposes, will be the miscellaneous apparatus for general oil testing, calorimetry, and instrument calibration, and the equipment for belt testing, which is made a special feature of the course. The basement is devoted to hydraulic work, which includes pump and motor testing weir measurements, etc. In the university power station a simple Corliss steam engine, an Otto gasoline engine, and a Heine water-tube boiler are available for



SOME OF THE TESTING MACHINES IN THE OLD LABORATORY.
A PART OF THE OLD ELECTRICAL LABORATORY.

MECHANICAL ENGINEERING DRAFTING ROOM IN WINGATE HALL.
THE NEW MACHINE SHOP, WITH MACHINES PARTIALLY SET UP.

testing under operating conditions. With this equipment, together with the power tests in the machine shop above mentioned, a very valuable training in experimental work, covering three semesters, is given.

During the past year about 540 students have been registered at the university, considerably more than half being in the College of Technology. The marine work has been well patronized, and when the maritime interests of the country are placed on a proper basis, Maine, with her old-time traditions of the sea, will continue to supply trained men for the marine field of work.

The tuition charge is purely nominal in amount, being $30 per annum. Registration, incidental and laboratory fees, text books, etc., bring the regular fixed expenses up to about $100 per year. Living expenses in town and in the dormitory and various fraternity houses range from $4 to $5.50 per week. Few institutions in the country offering equal advantages can be found at which the expenses are as low as this.

The university is delightfully located in the town of Orono, on a branch of the Penobscot river, nine miles above the head of navigation. Both steam and electric railroads connect with the cities of Bangor and Oldtown, distant nine and four miles respectively. The campus, possessing many natural advantages, has been carefully and systematically improved until now it is one of the most beautiful of college grounds in the country. The buildings are plain but substantial and serviceable, additions being constantly made necessary by the rapidly growing student body. The climate is healthful and invigorating, and some of the best of Maine's wild and rugged scenery, and the hunting and fishing for which the state is famous, is within a few hours' ride of the university campus.

THE POSITION OF THE FIREMAN.

BY ROBERT S. RILEY.

We have all had our troubles with the fireman. The average engineer is pretty sure to be anticipating something unpleasant as he draws on his overalls for his first interview with the gang awaiting him below. Leaving port he is not surprised to find them half drunk and altogether unruly. The fires are not properly worked; there is confusion and trouble and ugly looks and words in the fire room. The second assistant, or whoever is in charge, has his hands full, and often resorts to words and tactics that are not becoming to an officer. He literally "puts on his fighting clothes" when he goes below. It looks for a time as if things were hopelessly mixed. Dodging slice bars, shovels, coal barrows, ashes, etc., makes the engineer wish himself "back on the farm again." Very likely, too, a gauge glass bursts about this time, or a blower engine runs hot, or a feed pump sticks. Life seems nothing but troubles for a while after getting under way. But no trouble is more annoying and serious than the friction and heat developed between the engineer and his unruly subordinates.

You really cannot do much with a fireman who cannot or will not fire. Generally it is impossible to watch them all, and you get no satisfaction until they get down to a sea-going basis. "You can lead a horse to water but you cannot make him drink" applies surely to the crowd that you get down in the fire room for the purpose of transforming coal into steam. Efficient firing calls for good-will first of all. For you can get nothing out of the most expert shovel handlers if they are indifferent or against you. Up on deck the officer or boatswain can see everything a watch of sailors does. The coiling of a rope, or the lashing of loose gear shows at once how it was done and all about it. Down below the fireman's work is not visible or subject to analysis after it is done. The sailor of the surly or unwilling type can do but little harm anyway, whereas, the fireman has the sped of the ship almost absolutely under his control. The engiher may hustle all he pleases in the engine room to keep things going at their best, but first of all he must have steam, and for this he looks to the fireman, not so much for his brute strength and endurance, though these he must have, as for his skill in building a hot fire. All sea-going engineers know what a difference it makes which watch of firemen is below, and often it is not the strongest men physically who make the best impression on the revolution counter. The writer has seen many cases where the light, brainy little men can keep the safety valves lifting where the big, powerful ones struggle in vain to get the pressure up. It certainly requires skill to burn coal to advantage.

Whenever a notable run is made we hear plenty about the "gallant captain" and his officers. Some times the chief engineer gets a little recognition, too, but how often do we hear any mention of the latter's subordinates, the men who really make the run? The engineer in charge of the watch is the man responsible for the record of his four hours, and he knows pretty well where to go when a special effort is required. Other things being equal, it is to the firemen of his watch that he looks for the maximum revolutions of his engines. The speed of the ship, then, depends entirely on the ability of the men who build the fires in her furnaces. The economy of the ship in the consumption of the owner's coal is, in the same way, dependent upon the efficiency with which it is burned.

The importance of the fireman is being shown up more and more with the advancement of steam engineering both in the merchant marine and in the navy. Our war with Spain brought it out most clearly during the blockade off Santiago, and the brilliant victory that ended it. To engineers and others conversant with the conditions of that blockade and chase, it must appear that it was something of a "fireman's fight," rather than simply a "captain's fight," as it has been called. The engineer's staff in general kept the machinery ready, but when the thing really happened it was up to the firemen to catch the Spaniards, and they did it.

Firemen, as a rule, are not a bad lot of fellows when at sea. There is a spirit of loyalty and rivalry about them that is quite exhilerating. It is the time-honored custom to rave more or less over the jolly sailor, what a fine fellow "Jack" is, etc. But one who has served with all sorts of crews finds that the firemen are better ship mates in almost every way than the sailors. Of course, there are exceptions, but for eye servants and chronic growlers please deliver us from the average sailor before the mast. Watch him cleaning around the deck and you will generally see that his only object is to pass the time until eight bells; then he drops into his bunk without many preliminaries such as washing. He cannot spare time, for one thing, for he is generally

"four on and four off" with a dog watch in the evening. For the fireman on watch there is no such thing as eye service. His business is to keep the seam-gauge finger over the right mark, and he knows it. The man who does this most easily is generally the best man. The quicker he slices, cleans, and fires, the more time he has to take it easy, and the efficiency of his service generally increases with his speed, while the amount of coal to be shovelled will decrease in like ratio. To the engineer there is nothing smarter or more impressive than a good watch of firemen at work.

The introduction of the water-tube boilers calls for still greater skill in firing, and so does the manipulation of oil fuel. In every way the fireman's responsibility is being increased and his skill and efficiency become of more and more importance to the ship owners. We have no grudge against the ordinary sailor, yet it must be admitted that his importance becomes less with the increase of machinery and its appliances; on a steamship he is hardly more than an ordinary laborer.

Now, if the fireman's good will and skill are such important factors in the engine-room efficiency, why is not more done to attract and keep the right kind of men? They are too important to be neglected. Consider the life of the average sea-going fireman. His sleeping quarters are located almost any place that is not useful for anything else. Ventilation is about the last thing that worries the owner or the naval architect. He sleeps on one of a series of shelves that look about as inviting as an opium den without the opium. His bedding, or lack of it, makes one envious of the nice blankets most horses have. But the most degrading feature of all is the manner of his feeding. Very often the food itself is clean and well enough cooked—not too often, however—but it is nearly always spoiled in the serving, if we dignify such a "hand out" by that name. Because a man is employed at an occupation involving as much dirt as firing, it does not follow that he cannot appreciate civilized treatment when off watch. Indeed, the only way to make a man self-respecting is to treat him with respect. To give a man his food in a trough is very likely to develop the grunt in his nature.

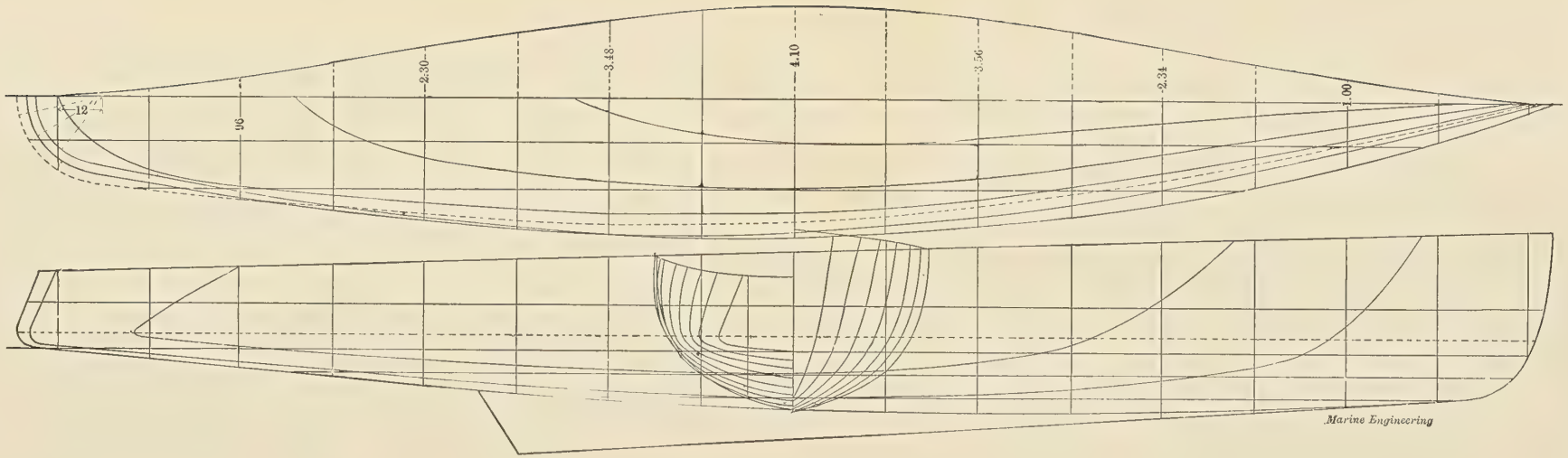
The fire room, generally, is not so bad as pictured. Indeed, many fire rooms are more comfortable than the engine rooms. Some of them are hot, but the ventilation is the best possible. Forced draft may be disagreeable on some ships but natural-draft fire rooms are often pleasant places. The air is good even if the fires are hot, and most of the four hours is not especially trying. Of course, when it comes to cleaning fires and handling ashes, there is more or less hard labor and exhausting work, but even this is not distasteful to a good, active man. There are only four hours of it, anyway. Eight bells comes shortly, and there are eight hours off. A good wash is the first thing, and this is where the fireman excels the sailor in every case. Whoever saw a watch of sailors take a good scrub as firemen do? It is true that they do not get as dirty so far as visible dirt is concerned, but the fireman more than makes up for his dirtier work by the cleanliness of his body when off watch. Most sea-going men agree that firemen are remarkably clean as to their persons. This is probably at variance with popular conception, but true never the less.

But what sort of a place has the fireman in which to spend his eight hours off watch? Usually a dirty, ill-ventilated hole that one does not care to enter or know too much about. It shows a lack of appreciation in the owners and naval architects that they should allot such quarters to men of whom so much is required. A reform is badly needed in this direction. Once the quarters are made respectable and the other living conditions given a better tone, it will not be long before a better class of men will be signed on, and they will not look upon their occupation, as so many sea-going firemen do now, simply as a last resort after all their money is spent ashore. There are a few foreign lines now in existence where the firemen are a thoroughly respectable class of men. The occupation is an honorable one and the pay is better than a similar one ashore, for there are no living expenses.

The chance of a pleasant life among firemen is strongly brought out by the Asiatic crews that one sees in the far East. The Chinese crews in particular have a way of making their forecastle a pleasant home. A Chinese "No. 1" fireman is something of a personage aboard ship. He has absolute control of the men and picks them carefully. They carry their own cook and servants. The quarters are kept scruptuously clean. The food is served in the most approved fashion of their caste. They maintain a dignity and self-respect that gives them a very comfortable and honorable position on board the ship. It is also a permanent one. The Chinamen in this business are highly respected, and this is simply because they have shown themselves worthy of it. Now, why should not our white firemen take a lesson from this? It is true that we expect a higher standard of living from them than from the Chinese. This is granted. We give them more money. But do we give them the other treatment that should go with it?

White men of the class we want do not live in the manner that they are obliged to as firemen on board ship. The firemen's bath room should be convenient and well equipped for its important service in the comfort and cleanliness of the men. The sleeping quarters should be airy and well ventilated, no more than three or four men being put in the same room. Above all the sleeping quarters should be for sleeping only, and no food should be eaten there. A proper mess room should be provided with gear enough to give them a service suitable to their station in life. For their leisure hours, both at sea and in port, they should have the freedom of a suitable room or compartment where they could spend the time decently. Surely they deserve as good or better than the steerage passengers. Our modern ships now make it very comfortable and pleasant for the latter. Why should not their skillful and tried firemen be worthy of the same improvement in their living conditions? Here lies a great need for improvement and one that would repay the expenditure necessary. The efficiency of the firemen is of great importance to the owner of ships, and he would do well to invite a better class of men than is attracted by the present conditions.

Marine Disasters for May.—The administration of the Bureau Veritas reports that during the month of May there were lost from the combined merchant marines from various accidents, such as stranding, collision, fire, condemned, etc., 66 sailing vessels and 40 steamers.



LINES OF 32-FOOT SPEED LAUNCH ADJIDAUMO.

Thirty-two-Foot Speed Launch Adjidaumo.

Hale House, one of Boston's social settlements, has a camp for boys on Lake Asquam, N. H., adjoining the summer home of the president, Mr. H. B. Sawyer. From the nearest railroad station at Ashland the water route leads through a narrow and tortuous river into the lower lake, thence to and through another river and the full length of the upper lake, a distance altogether of thirteen miles. Mr. Sawyer's business in Boston makes him dependent on trains, and he found the regular steamer service, with its numerous stops, took up too much of his time.

Accordingly the launch *Adjidaumo* was designed to meet the following requirements: Speed not less than twelve miles an hour, construction specially strong, because of the danger of running on submerged rocks; a quick helm, to take sharp bends, and equipment such as to be easily handled by one man. The boat was, moreover, to be at the disposal of the camp, and must, therefore, be able to carry a dozen or more people with comfort, and stiff enough so that all of them on one side should not endanger a capsize. The dimensions and

MARINE ENGINEERING DATA CARD. **AUGUST, 1904.**

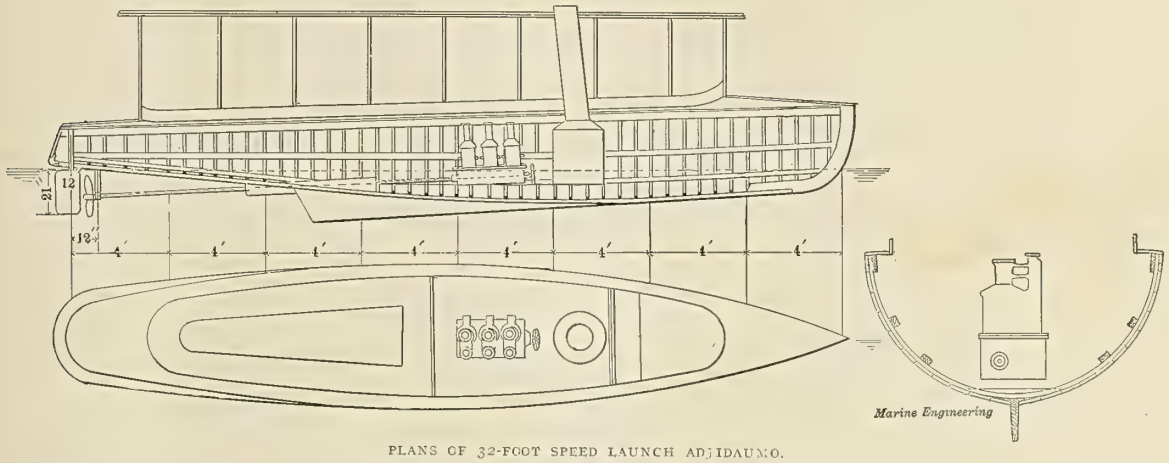
NAME—Adjidaumo. NATIONALITY—American. TYPE—Motor launch.
LAUNCHED—1903. DESIGNER—Edmund B. Edwards. OWNER—H.B. Sawyer.

Length over all	33 ft 5 ins.
" water line	32 " 0 "
Beam, extreme	6 " 0 "
" water line	5 " 0 "
Draft, to rabbet	0 " 16 "
" extreme	2 " 3 "
Freeboard, forward	2 " 8 "
" midship	2 " 2 "
" aft	1 " 8 "
Displacement, loaded	4,350 lbs.
Scantlings: keel, white oak,	sided, 6 ins.; molded, 2 ins.
Stem, white oak	sided, 2 "
Plank, cedar	3-4 "
Garboard and sheer strake	oak
Skag, oak,	sided at top, 2 ins.; bottom, 1 in.
Frames, white oak, sided, 1 1-4 ins.;	molded, 7-8 in.; spaced, 8 ins.
Floors, oak, sided 1 in.; molded, 2 ins. in throat	
Clamp, hard pine	1 by 4 ins.
Bilge stringers, 4 hard pine	1 1-2 by 2 1-2 "
Deck, white pine	7-8 in.
Fastenings	copper-riveted over burrs
Engine:	Buffalo, four-cylinder
Builders rating	14 H. P.
Cylinder diameter	4 1-2 ins.
Stroke	5 "
Crank shaft, diameter	1 1-2 "
Floor space	21 1-2 ins. length by 9 3-4 "
Fly wheel, diameter	18 "
R. P. M., in service	450
Weight, engine	565 lbs.
" reversible gear	150 "

scantlings are given in the data card. A steam engine of original design and a coil boiler with oil burner were first installed, but these were removed, principally as it was found that the attention of an extra man was required. This is the power shown in the cut. A gasoline engine was later substituted.

The engine is a 14 horse power Buffalo motor, and the coarse pitched propeller, designed for the steam engine, keeps the revolutions down to about 450, so that the actual power is not far from 10 horse. With this power *Adjidaumo* makes better than 12 miles, beating all the steamers on the lake, and running the thirteen miles, including run through shallow water and sharp turns, in an hour and three minutes. With her steam rig her speed was about 15 miles. She will turn in a circle of 70 feet diameter, is very stiff and is dry in the short chop of the lake.

The *Adjidaumo* was designed by Mr. Edmund B. Edwards.



PLANS OF 32-FOOT SPEED LAUNCH ADJIDAUMO.

Navy Engineering Laboratory.—A civilian architect has been called in consultation in the preparation of the plans for the experimental laboratory for naval engineering at the Naval Academy. Little has been accomplished in the last year, although an appropriation for such an establishment was made by congress some time ago. To an officer, Lieutenant Commander Walter F. Worthington, of the Bureau of Steam Engineering, has been assigned the duty of developing the project. The establishment will not only be devoted to work of interest to the service, but will conduct experiments and make tests of apparatus offered to the navy by industrial concerns. The present facilities in this respect are limited, and are confined to what may be spared from the contingent fund, from the Bureau of Steam Engineering, and from the means of experiment at the larger navy yards. Naturally, the opportunities for doing work of this kind are not extensive. When the laboratory is in operation at Annapolis it is intended that investigations of great importance shall be conducted. Institutions of a similar character abroad have been examined by our naval attachés, who have made reports in regard to them, and it is intended to apply the latest and best devices to the Annapolis establishment.

Merchant Marine Commission.

The sessions of the Merchant Marine Commission were resumed in Chicago the last of June and following meetings were held in Detroit and Cleveland. Much interesting testimony was submitted before the commission at these cities by men prominent in marine lines. The commission has been hospitably entertained by the boards of trade of these three cities and its work has aroused general interest.

The testimony at Cleveland of Mr. J. C. Wallace and of Captain A. B. Wolvin, were doubtless the most important given on this western trip. Mr. Wallace, vice-president and general manager of the American Shipbuilding Company, said that he firmly believed that the time had arrived when measures should be taken for protecting ships in the foreign trade. The general condition on the Great Lakes was satisfactory as all had been done for the ships that could be done.

He declared, however, that, in his opinion, subsidy would not benefit the American shipbuilders, and proceded to give his reasons therefor. He stated that 100,000 tons of steel had been sold at Belfast at $24 per ton, which would be $22 at tidewater, as against $32 Pittsburg charged to American shipbuilders. In a vessel consuming 6,000 tons of steel this would mean $50,000. Concerning the cost of shipbuilding and the employment of skilled labor at home and abroad, he stated that the American workman had the advantage of better machinery, and mentioned especially the fact that pneumatic tools are in far more general use in the ship yards of this country than they are abroad.

In reply to a question, Mr. Wallace stated that Harland & Wolff were the purchasers and the United States Steel Corporation sellers of this order. Continuing, he stated that from his experience in the lake trade, cost of American-built ship was 40 per cent. more than the English-built ship.

Mr. Wolvin submitted figures concerning the operation of the Swedish vessels in his line, the Great Lakes and St. Lawrence Transportation Company. The cost of operating the Swedish steamers is fully 40 per cent. less than the cost of operating the American vessels of similar tonnage in the same company.

Hudson River Steamer Mary Powell.

Of all the river steamers plying from the port of New York, none is so well known or so general a favorite as the side-wheel passenger steamer *Mary Powell,* known for many years past, and rightly so, as "Queen of the Hudson." The original wooden hull was built by the then well-known shipbuilder, M. Allison, of Jersey City, the keel being laid in the year 1861, and the vessel completed in the year following, the engines and boilers being built and installed by the firm of Harrison & Fletcher (now W. & A. Fletcher), of North River, N. Y.

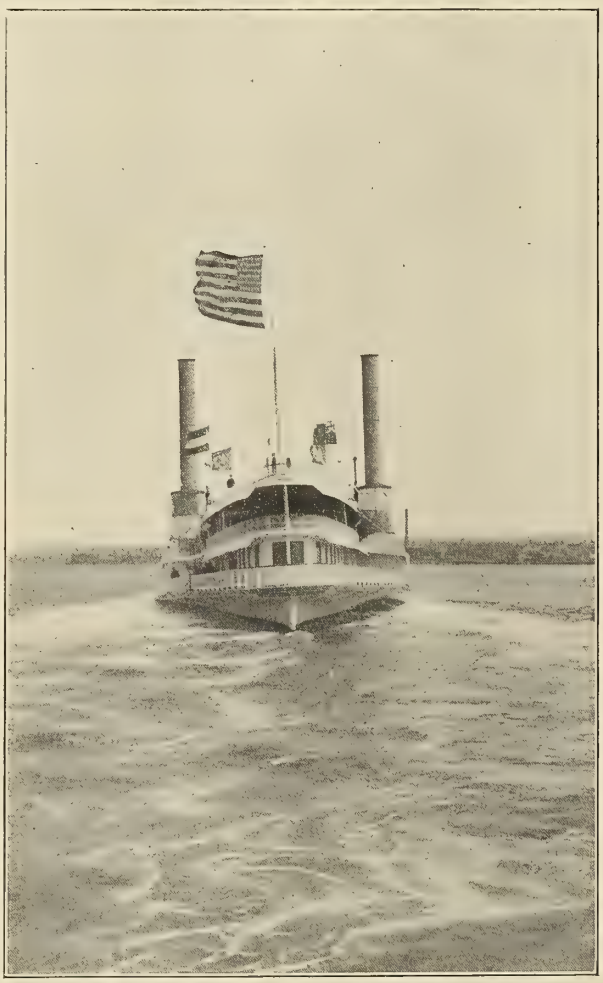
The building, launching, and early life of the *Mary Powell* were themes of unfailing public interest, for she was considered a big boat in her day, and one of the finest examples of American naval architecture, pictures and descriptions appearing in the leading magazines of the old and new worlds. Since those early days many repairs and renewals have been made to the hull and machinery, so that now it would be a difficult matter to find a piece of wood or metal which lent strength or beauty to her when launched, but the lines have been so carefully preserved that there has been no deviation from her original construction. We find in the records of the Supervising Board of Steamship Inspectors that the wood hull was entirely rebuilt by the New Jersey Dry-Dock Company, Elizabeth, in the year 1897, new steel boilers having been built and installed six years previously by the firm of McEntree & Rodie, of Rondout. These two boilers were of the tubular type, 27 feet in length, 10 feet 8 inches diameter of shell, 11 feet 6 inches width of front, and allowed a working pressure of 45 pounds reduced latterly to 38 pounds per square inch.

In talking of the speed of the *Mary Powell,* the owners say that in the year 1881 she made her record run between New York and Roundout, with eight landings, in 4 hours and 12 minutes, a distance of 100 miles.

This winter the boat has laid at the yard of the Townsend-Downey Shipbuilding Company, Shooter Island, N. Y., undergoing extensive repairs to her machinery, having new steel boilers built and installed, new smoke stacks and steam pipes, and new paddle wheels of the fixed bucket type, of slightly less diameter, substituted for the old of the same type, 33 feet outside diameter.

Looking at the accompanying photographs it will be seen that the paddle wheels are well forward and boilers are placed on the guards just abaft the paddle boxes. This position was quite usual in the days when this boat was built, and one which did away with the heartburnings of present-day designers when arranging passenger accommodation, but it is now seldom seen, being prohibited on later-built vessels by the Board of Supervising Inspectors. This winging out of the weights of boilers accounts for the stability of the *Mary Powell* although possessing such an exceeding fine hull. Owing to this fineness of hull, unusual care had to be taken by the Townsend-Downey Company in lowering the new boilers, which weighed, when shipped, about 25 tons apiece, that both boilers should rest in their saddles at the same time. The job, however, was successfully done, and the boilers shipped with barely a movement in the boat other than changing the draft.

In many ways the career of this vessel has been unique, in that she was built to the order of Captain A. L. Anderson, father of her present captain, and was owned entirely by that family up to a few years ago, when the controlling interest passed to the Hudson River Day line, but Captain A. E. Anderson, who relieved his father some thirty years ago, is still in command. She is also what is known as a lucky ship, in that during her whole career she has had no accident which entailed injury to either her passengers or crew; in fact, the only accident on record is one that happened some four years back, when both her smoke stacks were carried away during a summer squall off Peekskill, and in which the captain tells with pride how they continued the trip, making all landings on time.



THE FAMOUS HUDSON RIVER STEAMER MARY POWELL.

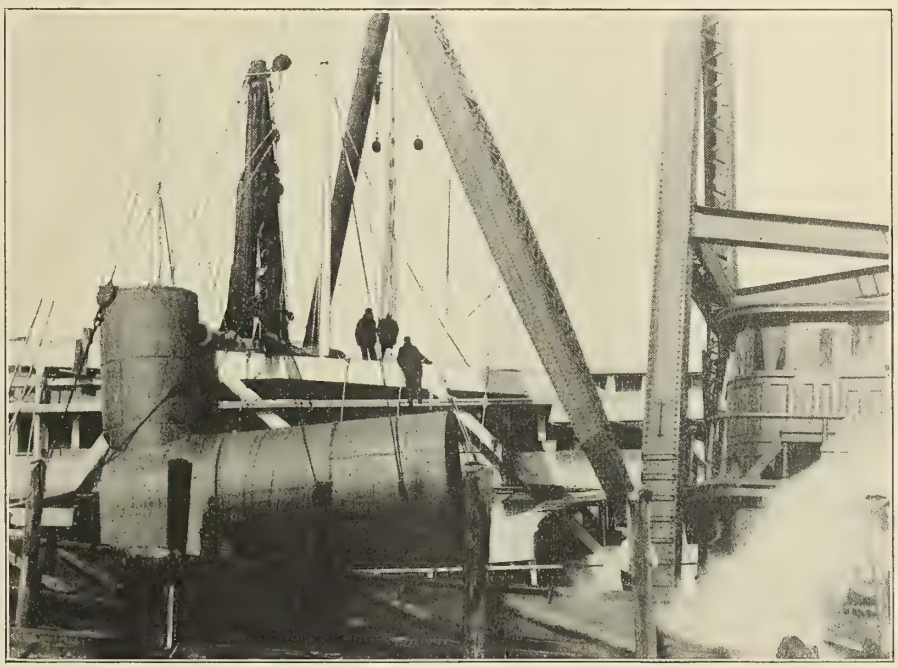
Particulars of the *Mary Powell,* as she now stands, are as follows:

Length, over all	300 ft. 0 ins.
Length, between perps	286 ft. 0 ins.
Length, on load-water line	288 ft. 9 ins.
Beam molded	34 ft. 4 ins.
Beam, over guards	64 ft. 0 ins.
Draft, mean	6 ft. 0 ins.
Displacement, about	800 tons
Midship section	170.5 sq. ft.
Block coeff	.494
Gross registered tonnage	983 tons
Number of passengers	1,700

Engines. Type, standard condensing beam engine.
Cylinder diameter ..... 72 ins.
Stroke ..... 12 ft.
Indicated horse power..... 1,560
Revolutions 27

Boilers. Number and type.....2 tubular
Length ..... 27 ft. 0 ins.
Width of front..... 11 ft. 6 ins.
Diameter ..... 10 ft. 8 ins.
Tubes ..... 80, 5-in. tubes, 19 ft. long

THE FAST RIVER STEAMER MARY POWELL, FITTED WITH NEW BOILERS.



SETTING THE NEW BOILERS IN PLACE ON THE STEAMER MARY POWELL.

Paddle Wheels. Fixed floats. Wood.
Outside diameter ..... 31 ft. 9 ins.
Number of floats (buckets)..... 26
Width of float..... 10 ft. 6 ins.
Face area of floats..... 15 1-2 sq. ft.

Flues, one boiler.....2, 18 ins. dia.; 4, 16 ins.; 2, 15 ins.; 2, 12 ins.; all 10 ft. 10 in. long.
Working pressure ..... 45 lbs.
G. S., two boilers..... 156 sq. ft.
H. S., two boilers.....5,664 sq. ft.

Westward Run of the Oil Burning Steamship Nebraskan.

On June 10, the steamship *Nebraskan,* of the American-Hawaiian Steamship Company, arrived in San Francisco from New York, after a successful voyage, burning oil as fuel. A supply of Texas residuum oil taken on board at New York, lasted for the complete voyage. In the May issue the eastward passage of this ship, burning Bakersfield oil, was described. A comparison of the two trips may be made from the following summary of the westward passage and the eastward passage, as given on page 208 of the May issue.

	DAYS.	HRS.	MIN.
Time of voyage	54	6	42
Steaming time	52	11	27
Stoppage at sea		4	11
Detention in Strait of Magellan	1	15	4
Distance covered, nautical miles			13,135
Draft, mean, leaving			25 ft. 6. ins.
Draft, mean, arriving			22 ft.
Displacement, mean, for trip			8,576 tons
R. P. M.			73.39
I. H. P., main engines			2,010
I. H. P., total			2,220
Average speed, knots			10.43
Slip of propellers, per cent			15.2
Ship docked previous to leaving.			
Oil, Texas residuum, 22½B. at 60° F., total bbl.			9,687.7
Barrels of oil per hour			7.69
Pounds of oil per I. H. P. per hour			1.12
Miles per barrel of oil			1.36
Air pressure at fan			.8 to .9 ins.
Air pressure at blowers			1.25 lbs.
Temperature of oil in heater			90 deg. F.
Temperature at base of stack			430 to 450 deg. F.

So successful has been the performance of this ship that two other vessels of this company, the *Alaskan* and *Arizonan,* are to be fitted with Lässoe-Lovekin oil burners, similar to those on the *Nebraskan.*

Erratum:—In the data card on page 208, May issue, oil bunker capacity should be 10,500 barrels instead of 1,200 barrels.

Annual Shipbuilding Returns.—The Bureau of Navigation reports 1,092 sail and steam vessels of 349,573 gross tons built in the United States and officially numbered during the year ended June 30, 1904. Of this total 55,177 tons were wooden sailing vessels, most of which were built on the Atlantic and Gulf; 39,891 tons were wooden steam vessels. Of the steel tonnage only 5 vessels of 15,374 tons are sailing ships built on the Atlantic; 47 of 97,981 tons are propelled by steam, built in the same district, and 41 of 139,898 are of the same class. built on the Great lakes. During the corresponding year, ended June 30, 1903, 1,215 sail and steam vessels of 376,502 gross tons were built in the United States and officially numbered. The wooden tonnage built this year is about 12,000 tons greater than last year, most of the increase being on the western rivers. There has been a falling off of the steel tonnage on the Atlantic, but an increase on the Great lakes. The unrigged vessels for 1904 number 216 of 51,844 tons, and for 1903 320 vessels of 79,574 tons.

Austrian Cranes.

BY FRANK C. PERKINS.

The illustrations on the opposite page show two most interesting types of cranes recently installed at Triest by J. von Petravic & Company, of Wien-Hernals, Austria. The pontoon crane has a capacity of 30 tons, raised at the end of the beam, which projects 46 feet beyond the float, and is operated by steam power. The height is 73 feet over all. It was constructed for the Arsenal der Dampfschifffarts-Gesellschaft des Oesterreichischen Lloyd, and for the "Stabilimento tecnico Triestino."

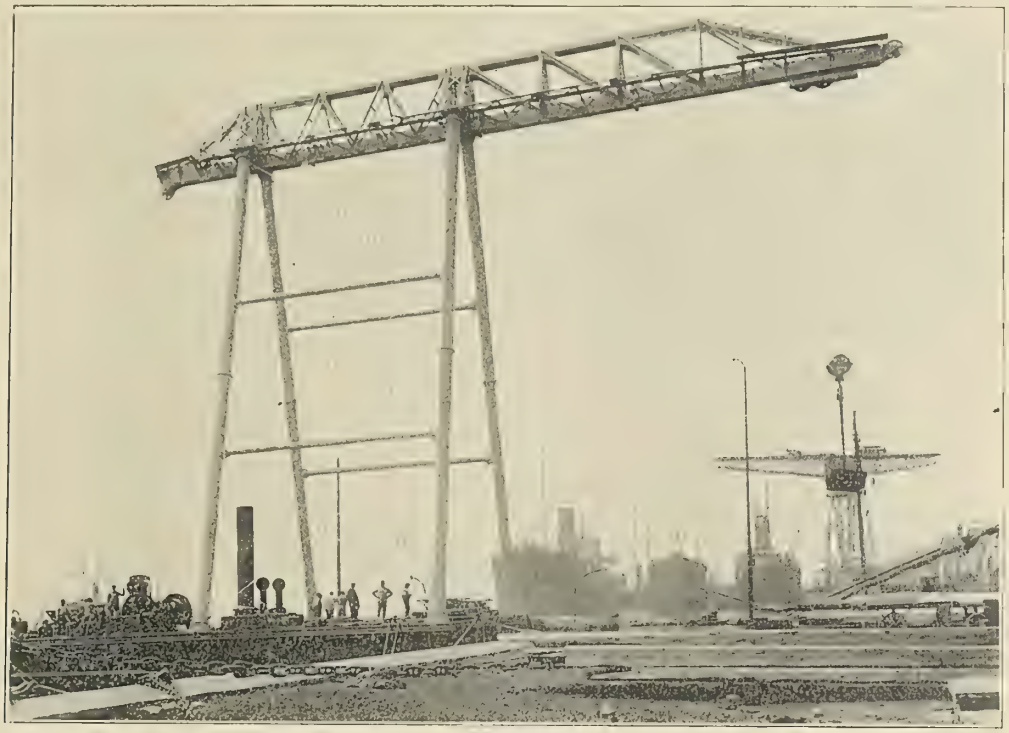
The wharf crane, shown at bottom of page, is operated by electric power and was constructed for the Steam Navigation Company of the Austrian Lloyd at Trieste. The work of this crane is to place or remove complete sets of marine engines and boilers of ocean liners and battleships in the shortest possible time, and also to handle at high speed the lighter weights for the general loading. This last duty is of the greatest importance because as a rule cranes built for heavy work will work with a low efficiency and too slowly when used for lighter service, which frequently forms the greater part of the work carried on at any ordinary wharf. Therefore, the adaptability of this crane to all kinds of work, makes it unique. The total height of the crane is 112 feet and it has a maximum projection of 66 feet at the short jib with a load of 35 to 170 tons, and a maximum projection of 100 feet at the long jib for loads up to 35 tons. The maximum load of the big trolley and short jib of this wharf crane is 170 tons, while the maximum load of the small trolley and long jib is 50 tons.

The small trolley has a lifting speed of 100 feet per minute and a traveling speed of 65 feet per minute, while the big trolley has a lifting speed of 1.8 feet per minute and a traveling speed of 27.5 feet per minute, while the slewing speed is one complete revolution in six minutes. All motions are attained by the use of series-wound electric motors and the speeds above referred to are for maximum loads, while with smaller loads the speeds will be proportionately faster.

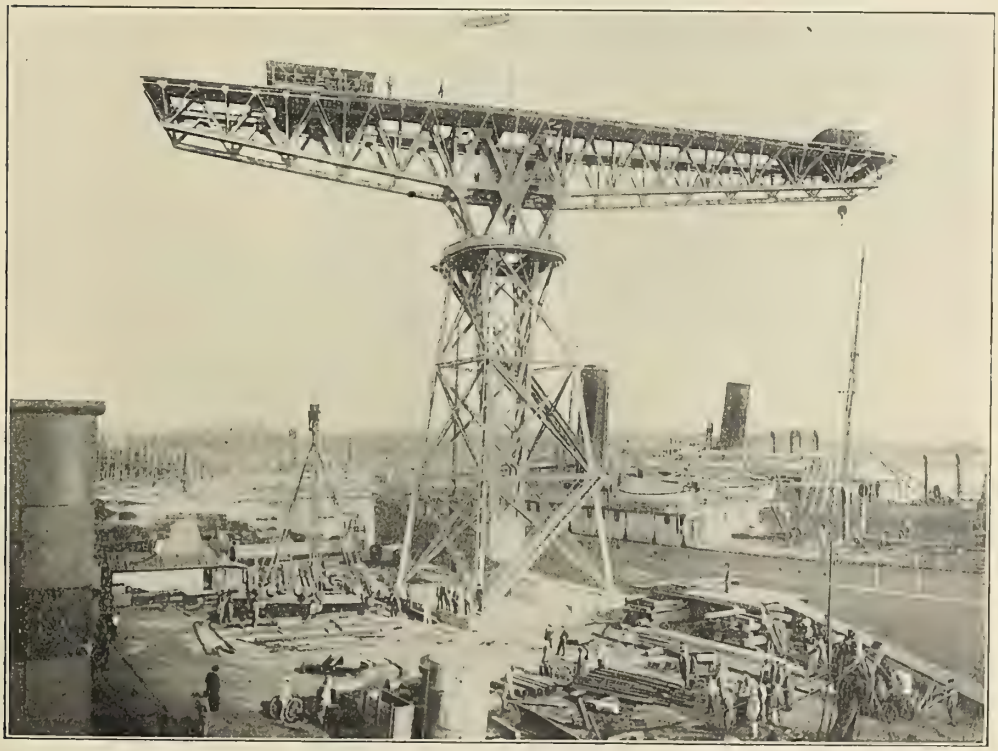
The crane is operated from a place well protected against the weather, the electric installation being such that the crane is always under the most perfect control. The whole crane is provided with automatic lubrication.

The wind pressure is said to be reduced to a minimum as the crane will automatically work like a weather cock. A large crab is erected on the short jib for heavy loads only with weights up to 300,000 pounds, while on the long jib a smaller crab is erected for lighter loads up to 70,000 pounds, operating at the various speeds above mentioned. As a counter weight when heavy loads are being raised by the large crab a ballast car has been constructed to act along with the small crab, but when light loads are being raised the great crab itself is sufficient to act as a counter weight. A most ingenious arrangement has been adopted to enable the crane to work automatically, independently of the crane man. The large crab cannot lift loads unless the small crab together with the ballast car has reached the further end of the jib, and similarly the small crab cannot lift loads unless the large crab has obtained the utmost end of the jib and the ballast car rests above the center pin of the crane. The stress on the crane post and power to operate traveling motion, are reduced to a minimum.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 137 vessels of 51,607 gross tons built in the United States and officially numbered during the month of June. The largest steel steam vessels included in these figures are the *Minnesota,* 20,718 gross tons, built at New London, Conn.; *Sahara,* 5,785 gross tons, Lorain, Ohio; *City of Atlanta,* 5,433 gross tons, Chester, Pa.; *Martin Mallen,* 4,635 gross tons, Cleveland, Ohio.



PONTOON CRANE.



WHARF CRANE AT TRIEST, AUSTRIA.

Marine Engineering

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THE steam turbine, for marine propulsion, still continues to hold the center of the stage in point of interest for the marine engineer. This is shown by the recent output of literature on the subject, as well as by the reports of actual progress which the turbine is making in present-day and prospective designs. The most notable feature of recent progress is the report of the Cunard Commission in favor of the turbine for the new ships projected by that company, and the entry of this type of prime mover in this manner at one jump into the very front rank of marine practice. The general advantages claimed for the turbine are now too widely known to call for mention here, and our present purpose is rather to call attention to one or two special features suggested by the synopsis of the report which has been made public.

To the great surprise of all engineers the commission report that the saving of weight to be anticipated by the adoption of turbine machinery is only some 300 tons, an amount so inconsiderable in comparison with the total as to remove the saving of weight from among the advantages which might be expected from the turbine outfit. Such an amount is, in fact, so small, that but slight changes in the design might wipe it out entirely or throw the balance in the other direction. The same general conclusion seems also to be reached with regard to space occupied, especially in terms of fore-and-aft length of engine room. The commission in fact recommends that the 300 tons margin in weight be held in reserve for machinery design and not added to cargo capacity or absorbed for other purposes. These results are distinctly disappointing, particularly as regards the negligible saving of weight with turbine machinery, especially as in the smaller installations of torpedo-boat size, as well as on the Clyde and English channel steamers there seems evidence of a considerable saving in weight as compared with reciprocating engines of the same power and of type suited to the same general purpose. Engineers will therefore await with keen interest some further information regarding the basis on which these estimates of weight were made, and how it is that the saving which seems to be demonstrable with a relatively small installation of 2,000 to 6,000 I. H. P. disappears with an installation of 75,000 I. H. P. Regarding this matter of weight two points may be noted: First, the turbines contemplated in the design are of the Parsons type, and these are especially exacting in point of length occupied. It may well be therefore that in point of weight they are somewhat heavier than some of the other designs of multiple effect turbine, such as the Curtis or Rateau, though naturally data are lacking for any accurate comparison. Second, even though this were true, it does not explain the apparent loss of a weight saving which smaller installations of the Parsons type seem to have demonstrated. It must be remembered, however, that the installations on which such saving seems to have been shown are small and of relatively high revolution types, for the most part from 600 to 1,200 r. p. m. The proposed revolutions for the Cunarders are 140, chosen, doubtless, as a compromise figure between the requirements for best results with the turbine and those for best results with the propeller. Under these circumstances and dealing with units of about 18,000 I. H. P. size, it may well be that a saving of weight which is real in the field of torpedo-boat practice disappears in the case of the transatlantic liner.

When we remember, however, the relatively

rapid spring of the turbine into prominence, the few years of experience with it as a prime mover, and the small effort which has thus far been expended in any serious attempts looking toward a saving of weight, we may confidently look for the future to produce such improvements in design and structural detail as shall serve at least to reduce very materially the weight figures which prevail in present turbine practice.

Another point of great importance has been above referred to in connection with the combined economy of the turbine and propeller. It must never be forgotten that the final measure of propulsive efficiency is the power which is usefully applied in the propulsion of the ship, and that this will depend on the propeller as well as on the turbine. Of these two items neither must be sacrificed to the other, but some compromise must be effected in which each shall have fair representation. It will usually result that the best conditions for both cannot be fulfilled simultaneously, and that a compromise is therefore called for. In particular, designers of turbine machinery must realize the important fact that the efficiency of a turbine operating under the most economic conditions possible may be entirely wasted and rendered of no avail by an inefficient propeller.

Another item of importance in connection with the report of the Cunard Commission is in the recommendation for Scotch boilers, presumably without superheaters. The recommendation of Scotch boilers was presumably dictated by two considerations: (1) conservatism regarding use of water-tube boilers on a transatlantic liner, and a natural tendency to stand by the type which has served so long and so well in this field until the advantages of the water-tube type for such service shall be more clearly demonstrated than at present; (2) smaller need for high steam pressure with the turbine than with the reciprocating engine. Curiously enough the latter seems to respond more readily as regards gain in efficiency to an eleavtion in the initial temperature and pressure, while the latter responds similarly in more marked degree to a decrease of the final temperature and pressure. Hence we find for the turbine an imperative demand for the lowest possible final pressure and best possible vacuum in the condenser.

Again, while the use of highly superheated steam has been shown to be productive of a pronounced saving in the steam turbine, the omission of superheaters from the design implies a hesitation on the part of the commission to add the necessary weight and complexity which such an outfit would entail. This, however, is an item possibly subject to later revision, and presumably needing, in the opinion of the commission, some further experience in connection with the practicability of superheaters as a feature in present-day marine practice.

The status of the steam turbine as a factor in the field of marine propulsion seems now well assured, and every engineer will do well to keep his eyes and ears open to the trend of practice in the direction of this new type of prime mover.

THE coroner's jury which investigated into the cause of the *Slocum* disaster has held the owners and officers of this vessel guilty of criminal negligence, and censured the inspector for incompetent and indifferent inspection. The federal jury is, at the time of writing, in session, and promises a thorough probing of the matter; and the superficial investigation of the United States local inspectors is at present under way. This accident has been discussed with great detail in the daily papers. Thorough ventilation of the causes and conditions were made, and every citizen is more or less familiar with the fearful disaster whereby 958 lives were lost, more than during the entire Spanish-American war.

Are there any evidences of reform, either in the administration of the laws by the government, or in living up to the spirit of them by the steamboat owner, or is there an overwhelming public demand for adequate protection? We regret that there is little such spirit manifest. The very next day following the disaster another crowded excursion steamer passed the *Slocum* wreck. Steamboat companies do not report any falling off in receipts. It appears, therefore, that while the inflammable construction, absolute disregard to ordinary precautions of safety—such as boat and fire drill on the part of the officers and crew, poor life preservers, and fire-fighting equipment on the part of the owners, and criminally inefficient steamboat inspection under obsolete rules—while all these are immediate causes, the underlying cause appears to be that our public at large is willing to take as great chances in its amusements as in its business. If this be true, neither steamboat company nor government will be awakened to its responsibility.

REPAIRS.

A Sea-Valve Job.

Editor Marine Engineering:

Some years ago, while employed by a well-known dredging company, we had occasion to add a sea valve or river cock, for independent supply to circulating pump. The dredge, a large hydraulic affair having a wooden hull, had been thoroughly overhauled the winter before, at which time the surface condenser and centrifugal pump had been installed. The condensing up to this time had been accomplished by a jet apparatus, but not entirely satisfactory. It was first intended to obtain water from a pipe already in use for supplying main feed pump, injectors, deck pump, etc., but the quantity being more or less irregular lowered the efficiency of the condenser; for that reason we decided to install the independent supply.

After some thought it was proposed to do the work without stopping the regular work of the dredge, and we accomplished the job in the following manner, with a force of three men, machinist, carpenter, and diver.

Having the position located, we first held the velve in place and marked off the bolt holes. Then removing the valve and finding the centers of the bolts we found the center of the opening in the valve, which was 10 inches diameter, and marked off a circle. The carpenter in the meantime had supplied himself with a dozen soft wood plugs, slightly taper, to drive into the bolt holes as soon as he withdrew the bit. With a piece of bent wire we found the exact thickness of the planking at this point, through one of the bolt holes, and by putting a collar over a flat-bottomed bit, the carpenter was able to bore the 10-inch circle full of holes and leave a bottom about half an inch thick. The hole he trimmed out carefully making a smooth job.

By this time the diver was ready for business. It may be mentioned here that the opening was about 4 feet below water line when the dredge was on an even keel, and would vary a foot or more as the dredge rolled. The bolts were 1 inch diameter of Muntz metal, with mushroom heads about 2 inches diameter, the body being a good driving fit in the holes. These bolts, when driven in place by the diver, drove out the wooden plugs without any leakage whatever.

We then made our joint, and bolted the valve in place. The only remaining thing was for the diver to bore a hole from the outside through the half-inch left by the carpenter, and with a small compass saw follow around the 10-inch hole. We then opened the valve to flush out any chips that might lodge on the seat, this being the only water we shipped during the whole operation, although we had taken precautions by having weighted canvass ready for instant use.

Bolting the strainer in place was but a few minutes' work and completed the job, the whole operation taking about 3 hours, and was considerably cheaper than dry-dock or railway. M. U. D.

A Home-made Diving Suit.

From time to time one hears of the ingenuity displayed by the captains and engineers of ocean-going vessels when called upon to make repairs at sea, and the following account, considering the simple methods employed, may be of interest.

When the Norwegian ship *Flora* was on the way to South Africa she sprung a leak, during a heavy gale, and the water rose rapidly in her hold. All hands manned the pumps, which were kept going till calmer weather prevailed, when the skipper, Captain I. Matson, adopted a clever and singular expedient for the preservation of his vessel. First he constructed from sail-cloth a bag 16 feet long, 6 feet in circumference, and 2 feet in diameter, with circular bottom. Between 5 feet and 6 feet from the bottom of the sack, and corresponding to the height of his eyes, he cut a hole and securely inserted therein a piece of glass. On either side of and a little below this window he made two smaller holes, to which he sewed water-proof sleeves made from a pair of overalls. In order to keep the bag open he fixed iron hoops inside at intervals of about 15 inches. When all was ready the skipper got inside the sack—his feet at the bottom, his face opposite the little window, his arms in the sleeves, tied tightly at the wrists—and was swung over the side near the leak. The strange apparatus and its occupant were lowered below the water until, through the window, the shipper discovered the leak, some 3 feet below the surface. The bag was, of course, open at the top, so the captain could see and talk with his men; the carpenter was at the bulwarks to lower necessary tools. Tackle, it should be explained, had been rigged up under the keel, with one block made fast to the bottom of the bag so that the latter could be pulled down over the leak and held in position. The skipper stopped the leak by filling up the hole with rope-yarn and nailing over it some canvass. During the rest of the voyage the ship made only one inch instead of six inches of water an hour. The captain was, at times, owing to the rolling of the vessel, 7 feet below the surface. The chaffing of the bottom of the bag against the ship wore a hole in the canvass; then the captain was pulled on deck, mended the hole, and was lowered again. On arrival at Cape Town he went down again and thoroughly calked the hole. E. C. B.

Standard Wins Challenge Cup.

The series of races held on June 23, 24, and 25 for the gold challenge cup offered by the American Power Boat Association, resulted in three successive victories for the *Standard*. The races were held off the Columbia Yacht club on the Hudson river, and while the entries numbered nine, there were only three competitors, on the first day: the *Standard, F. I. A. T. I.,* and *Water Lily* started; on the second and third days the *Standard* and *Water Lily* alone raced, the *F. I. A. T. I.* having sustained damage to her rudder soon after starting on the first day. The race was over a 16 nautical-mile course and return, and the *Standard's* time for the three days was 1:37.48, 1:33.30, 1:34.21. The average on the second day was 20.53 knots. The race was decided by points and was handicapped according to the rating of each competitor. With time allowances figured in, the *Standard* beat the *Water Lily* 5 minutes and 24 seconds on the first day, 3 minutes and 54 seconds on the second day, and 6 minutes and 51 seconds on the third day. There was general disappointment in the lack of interest or attendance at these races.

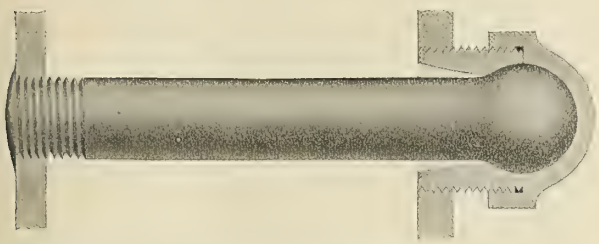
ENGINEERING SPECIALTIES.

Flexible Staybolt.

The delay, labor, and expense occasioned by the breaking of staybolts is appreciated by marine engineers generally, and many devices in the nature of flexible staybolts have been brought out to lessen the liability of breaking, but these have not as yet proved efficient. Lodgment of scale and sediment makes them rigid and some have a further defect of impossibility of inspection. The requisites for an efficient flexible staybolt are that it always remain flexible, allowing movement in every direction; that it may be readily examined; and that it be of full strength. These points are claimed by the Flannery Bolt Company, Pittsburg, Pa., for the Tate flexible staybolt.

This bolt, a cut of which is here shown, consists of three parts: first, the bolt itself, forged out of the best grade of puddling iron, the bushing or sleeve, which is of cold rolled steel, and the cap, which is of steel forging.

The sleeve is threaded on the outside with slightly tapering thread at one end, which is screwed into the outer plate, the remaining portion of the threads being



A NEW FLEXIBLE STAYBOLT.

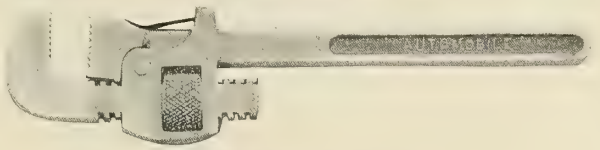
provided to engage the cap. This sleeve is made with a flaring mouth on the water space side, and is finished on the inside of outer portion in half-spherical opening, forming a joint with the half-spherical opening in the cap. The cap is recessed on the inside and threaded, and is also finished in a half-spherical socket opening, which when screwed over the sleeve forms a joint, thus making a perfectly spherical ball socket.

The bolt is manufactured elliptical, but when in working position it forms a perfectly spherical head, which is made to fit the spherical ball socket formed by the union of the sleeve and cap, and only needs threading at the end entering the fire-box sheet. In the installation of the Tate flexible staybolt a concave club is held against the head of the bolt, while the peening of the fire-box end is being done, thus making the head perfectly spherical when in position.

The points claimed by the manufacturer for this bolt are: That the head is spherical, having no plain surfaces or openings to invite the collection of sediment; that the cap is a protection for the head, easily removed for inspecting the bolt; simplicity and installation; increased safety and decreased cost of maintenance. Severe tests have been made of this bolt used on boilers located in bad water districts with very satisfactory results.

Pocket Pipe Wrench.

To meet the demand of motor-boat men and automobilists for a small and handy pipe wrench, the Walworth Manufacturing Company, 138 Federal street, Boston, Mass., has brought out a Stillson wrench, an illustration of which is herewith shown. The wrench is made of the best quality of tool steel, case hardened,



A HANDY STILLSON WRENCH.

and can stand the severest and hardest kind of usage. The serrated tempered jaws are 3-4 inch deep and open a full inch. The yoke is held in place by a pin and by a tempered steel spring. The length of the handle from jaw opening to end is 6 inches.

Efficient Fire Hose.

The equipment of vessels of all kinds with hose that can be thoroughly relied upon for efficient service in case of urgent necessity, is a matter that is uppermost to-day in the minds of owners of steam and sailing craft of every description. In nothing aboard ship is quality more necessary nor a matter of greater concern than in the brand of fire hose used. It is not a difficult matter to secure definite information regarding the vari-

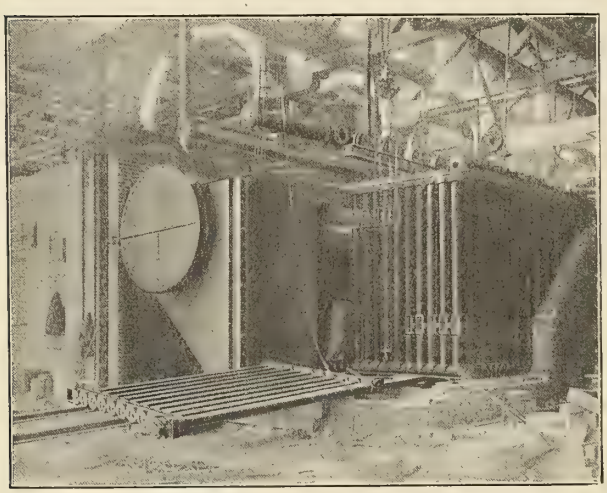
SECTION OF EUREKA FIRE HOSE.

ous brands of fire hose which are now on the market. The Eureka Fire Hose Company, 13 Barclay street, New York, N. Y., manufactures various brands of fire hose, one of which is illustrated on this page. This company, which claims to be the original and largest manufacturer of seamless-woven, rubber-lined, cotton fire hose, has supplied more than 1,700,000 feet of "Eureka" and "Paragon" fire hose to over 30 fire departments in the United States, and a single order from the New York city fire department aggregated 31,500 feet.

The "Eureka" fire hose, which is shown in illustration, is furnished in sizes from 1 to 4 inches internal diameter, and is what is known as a single-ply hose. It is a cotton hose, seamless-woven, and rubber-lined, and made milldew proof. The manufacturer states that this hose will stand a pressure of 350 pounds per square inch and is especially desirable for use where hose is kept attached to stand pipes, fire pumps, etc. The best hose is not expensive when we consider how much less the loss of life in the *Slocum* disaster might have been if that vessel had been equipped with some such hose as this.

Fuel Economizer.

The two most essential qualities of a fuel economizer are its ability to utilize most efficiently for heating water a maximum amount of heat from the escaping gases, and the accessibility of all surfaces for cleaning, repairing, and renewals. The Sturtevant economizers were designed to make possible these two requisites. By a system of staggered pipes the hot gases encircle each pipe, increasing the effective heating surface to a maximum. A fuel economizer must be accessible both inside and outside, and to make this possible the joints of the Sturtevant economizer are made taper metal to metal, specially suitable for high pressures, and are so designed that any pipe can be taken out and a duplicate substituted without disturbing any other pipe, section, or side walls. This would not be possible if packing, cement, or rusting were used to make tight joints. Any header or section can also readily be withdrawn and a duplicate replaced. There are no connection pipes to remove and all water surfaces are rendered accessible by the simple removal of the caps.



STANDARD ECONOMIZERS IN FURNACE FLUE.

The scrapers are interchangeable and the driving mechanism positive in action. A guide plate for the scrapers is used to insure the scrapers position and prevents them from sticking and breaking.

While the economizers are not designed for forced circulation, the connections are made in such a way that the flow of water is started in the right direction and tends to keep the flow up and down the consecutive sections without making undue work for the pump.

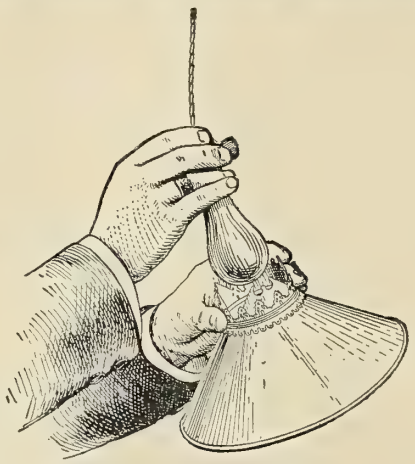
Two general types of economizers are made by the B. F. Sturtevant Company, Boston, Mass., the Standard and Pony, the former adaptable to power plants of almost any size, and the latter, as its name implies, is smaller and is more adaptable to power plants of 350 horse power or less.

All machines are made of the best cast iron for the purpose. All parts are tested to 350 pounds pressure before leaving the works and guaranteed to be sound and tight. All parts are machined to special gauges and kept in stock so that duplicates can be furnished without delay.

The several installations of these economizers are stated to have proven highly efficient; the gases are reduced to a very low temperature with a comparatively small amout of heating surface, and the water has also been heated to an exceptionally high temperature. In cases where the feed water contains foreign substances the owners have found these machines to be especially valuable owing to their accessibility and ease of cleaning.

An Automatic Lamp Shade.

The accompanying cut is of an improved lamp, made by the General Incandescent Arc Light Company, 529 West 34th street, New York, N. Y. The holder can be quickly attached and removed from any size electric lamp, from 4 to 24 candle power, without removing the lamp from its socket and adjusting itself automatically

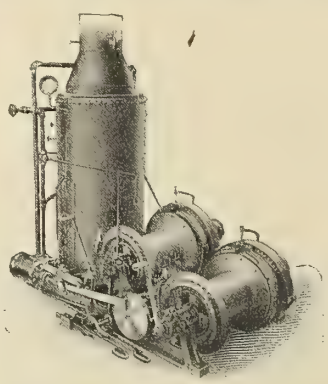


AN ADJUSTIBLE LAMP SHADE.

to the form of the lamp. The shades are light and ornamental, yet they are durable and made of water-proof cardboard, green on the outside and white inside. The holders are made in bright brass, nickle, or copper plated. The shade may be used on an upright or portable lamp equally well by simply bending the arms at right angles and adjusting from the inside of the holder.

Compact Hoisting Engine.

The cut on this page shows the double-engine and double-drum style of hoisting engine, mounted with boiler, made by the Stroudsburg Engine Works, Strouds-



DOUBLE-DRUM, DOUBLE HOISTING ENGINE.

burg, Pa. The effective points in this machine are its simplicity of construction, durability, and ease of

operation. In this make two winding drums are driven by friction cones with an improved arrangement of hardwood friction blocks. The drum is thrown into gear by forcing it against the wood friction surface by means of a screw, thrust pin, cross key and collar; the shaft is shouldered to take the thrust on the gear and the collar is screwed on the upper end to take the thrust against the bearing. The drum is forced out of engagement by simply throwing the friction levers back against the stop pin, no springs being required. The friction pins turn in an oil bath especially designed not to require close attention.

The cylinders have short stroke and each piston is designed for high-speed working. The cylinder drain cocks are simultaneously opened or closed by one lever. The slide valves are fitted to work against vertical valve seats; the cross heads are of the well-known locomotive type with brass gibs; the connecting rods have solid ends and are smooth forged with provision in the boxes for taking up wear. All engines are built on the duplicate system from complete sets of jigs and templates to insure perfect interchangeability. This style of machine is built in various sizes of hoisting capacity, with double blocks from 2 3-4 to 24 tons.

United States Shipbuilding Company Foreclosure.

On July 2, Judge Lanning filed a decree in the United States Circuit court, at Trenton, N. J., ordering the sale of the property of the United States Shipbuilding Company in the foreclosure proceedings instituted by the Mercantile Trust Company and the New York Security and Trust Company on the two mortgages held by them for $15,000,000 and $10,000,000 respectively.

The decree orders that these total amounts be paid within ten days by the Shipbuilding Company, in default of which received James Smith, Jr., is appointed a special master to execute the sale by decree by offering all the properties at sale, separately, to be disposed of to the highest bidder.

The minimum bids which Judge Lanning authorizes the reciver to accept, and aggregating $11,100,000, are as follows: Union Iron Works, California, $1,400,000; Hyde Windlass Company of Maine, $135,000; Bath Iron Works, Limited, of Maine, $300,000; Crescent Shipyard Company of New Jersey, $125,000; Samuel L. Moore & Sons Company of New Jersey, $175,000; Eastern Shipbuilding Company of Connecticut, $125,000; Harlan & Hollingsworth Company of Delaware, $550,000; Canda Manufacturing Company, $200,000. Patent rights, good will, trade marks, book accounts, accounts receiveable, contracts, promissory notes, drafts, checks, etc., $50,000.

Minimum bids on mortgaged personal property of the following companies may be accepted: Union Iron Works, $300,000; the Hyde Windlass Company, $100,000; Bath Iron Works, Limited, $40,000; Crescent Shipyard Company, $25,000; Samuel L. Moore & Sons Company, $30,000; Eastern Shipbuilding Company, $20,000; Harlan & Hollingsworth Company, $135,000.

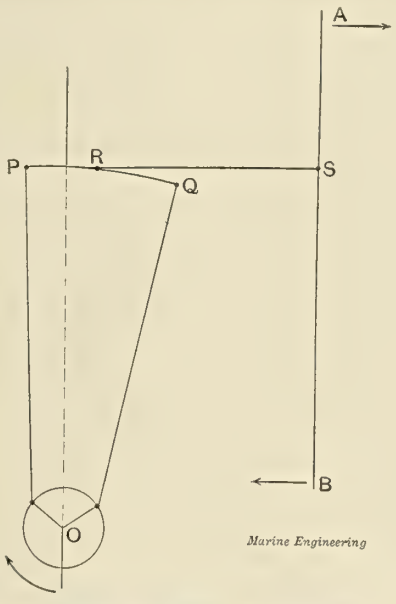
Three hundred thousand shares of the Bethlehem Steel Company, par value $50 a share, are to be disposed of for not less than $7,500,000. The decree specifies that the court may reject any or all bids or make such further orders as may prove necessary.

QUERIES AND ANSWERS.

Q. 220.—Will you please give me an insight into the principles involved in the operation of the valves of a steam-steering gear engine? R. L. H.

A.—The conditions to be fulfilled at the steering wheel are as follows:

So long as the wheel is at rest the steering engine must remain at rest and the helm fixed. If, then, the steering wheel is put over, say as for starboard helm, the engine must immediately start up in the corresponding direction and move the helm to starboard, continuing such motion as long as the wheel is moved, and stopping when the wheel stops; or, at least, running up to and stopping at the position which corresponds to the final position of the wheel when brought to rest. On the other hand, if the wheel is put over in the inverse direction, as for a port helm, the engine must start up in the corresponding inverse direction and move the helm over to port, and continue such motion so long as the wheel continues to move in this direction, in the same



manner as described for motion to starboard. The key to this complicated system of movements is found in the valve control of the engine. For a simple illustration of the principles involved let us suppose that the engine is controlled by a Stephenson link of the usual form, and that the link is so coupled up with the engine shaft by screw gearing or otherwise, that with the link thrown toward either end, the resulting motion of the engine will gradually move the link back to mid gear. Let the main items of this gear be represented in the diagram. The line *AB* represents a lever of which *A* denotes a point under the control of the steering wheel, and *B* a point under the control of the engine, as above noted. From *S* a connection is made with the link. Then with the engine at rest *B* is a fixed point, and movement of *A* to the right will throw the link to the right and out of mid-gear. The engine will thereupon start off with right-hand rotation moving the helm accordingly. Then when the wheel comes to rest *A* becomes a fixed point or center, and *B* is moved to the left by its connection with the engine. This results in throwing *S* to the left

and thus in finally middling the link and bringing the engine to rest. By moving *A* in the opposite direction a corresponding series of inverse movements will be set up and controlled. In this manner it may be seen that the various conditions above specified may be fulfilled.

In actual steering gears the Stephenson link and other connections are replaced by a variety of arrangements comprising reversing valves, movable eccentrics, etc., but all so adjusted as to bring about the same general series of movements. The Stephenson link is here used in illustration, not because it is commonly employed in standard types of steering gear, but because it is a familiar type of valve gear, and by its use the principles embodied in actual gears may be readily understood. With these principles clearly in hand any actual gear of the several types in common use may be studied intelligently, and the details of its operation readily made out.

Q. 223.—How much air is there in sea water?

(*b*) How does a ball nozzle work?

(*c*) How much oil used per horse power per hour in a modern triple-expansion marine engine?

(*d*) Why does a hot-water pipe freeze before a cold-water pipe under the same conditions?

(*e*) How would you strip a modern triple-expansion, vertical-inverted marine engine preparatory for a general overhauling?

J. H. H.

A. (*a*).—The proportion of air contained in average sea water may be estimated at about 20 parts by volume in 1,000. It may be noted, however, that the oxygen and nitrogen thus contained in water are not present in quite the proportion which constitutes atmospheric air. The proportion of nitrogen to oxygen in sea water is usually not far from 3 to 1, while in atmospheric air the proportion of nitrogen is somewhat higher. It may be further noted that the aeration of sea water is for the most part maintained by the lashing and agitation of the surface water by storms, and as seen in the familiar breaking wave crest. The foam, which is so familiar a feature of the breaking crest, is simply a mixture of air and water in such proportion that the water is no longer continuous, and comprises simply the film which constitutes the envelope of the air bubbles. Shortly after a storm the surface water is therefore highly aerated, and the contained air is then gradually distributed downward, thus maintaining a general average, as above noted.

(*b*) A complete explanation of the ball nozzle would require mathematical discussion of a character not suited to these columns. A fairly satisfactory understanding of its operation may be gained, however, by accepting the following principle: In a rapidly-moving jet or film of liquid the pressure is reduced far below the value which it would have with the liquid at rest and under the same head. This principle holds, likewise, with gases and vapors, and finds an important application in the De Laval steam turbine, where the pressure in the jet of steam is reduced, by its high velocity, from the full steam-pipe pressure to a value sensibly equal to that of the atmosphere. Accepting this principle it may be seen that the forces which act on the ball *B* may be grouped under four classes:

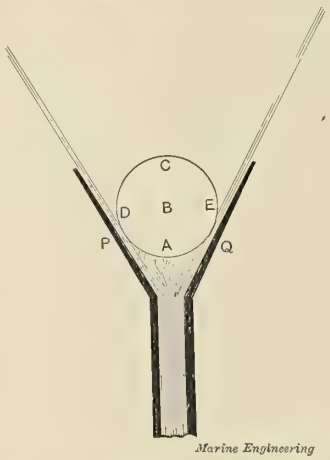
(1) Atmospheric pressure acting on the surface of the ball *D C E* and having a resultant acting from *C* toward *A*, and hence tending to hold the ball in the nozzle.

(2) The liquid pressure in the core of the liquid acting on the surface of the ball near *A* and tending to drive the ball out of the nozzle.

(3) The liquid pressure in the rapidly-moving film of liquid at *P* and *Q*, and acting on the surface of the ball near *D* and *E*, and having a resultant acting from *A* toward *C* and tending to push the ball out of the nozzle.

(4) The force due to gravity and represented by the weight of the ball. This force may act in one direction or another relative to the nozzle, according to the position of the latter, and so far as the present discussion is concerned may be left out of account.

Aside from the weight of the ball, then, the equilibrium of the ball in the nozzle means simply that, taking the action of the forces along the axis of the jet, force number 1 exactly balances the combined effect of numbers 2 and 3. It appears, furthermore, that within a somewhat narrow range of movement there is stability with regard to the position of the ball in the nozzle. That is, if the ball is moved outward in the direction *A C*, it will tend to return, and, conversely, if it is forced



inward in the direction *C A* it will, when left free, return outward to its position of equilibrium. This may be understood by reference to the changing values of forces 2 and 3. If we start with the ball close against the inner conical wall of the nozzle, then there can be no discharge at *P* and *Q*, and the ball is subject to the full static pressure of the liquid over the entire surface *F A Q*. It therefore moves outward, and once the film discharge established, we have the play of forces above noted. If the ball is forced in toward the bottom of the nozzle the pressure in the core of the jet becomes increased and pushes it out again. If, on the other hand, it is forced outward slightly the core pressure is further reduced, and the excess of atmospheric pressure will tend to carry it inward to the position of equilibrium. If, however, the ball is carried outward too far, the pressure within the film becomes increased, equilibrium is lost and the ball is driven outward on the moving jet. The operation of a ball nozzle is further modified by the rotation of the ball, and by the tendency of a film of liquid to curl and follow around the surface of the ball. The above partial discussion will, however, serve to show the more important fundamental principles which are exhibited in this interesting example of liquid discharge.

(*c*) Practice differs widely in the amount of lubricant required with modern marine machinery, but under average conditions from 5 to 8 pounds of oil per ton of coal, or from 5 to 8 pounds per 1,000 I. H. P. per hour will represent a fair allowance. In terms of liquid measure this will be somewhat less than one gallon per 1,000 I. H. P. per hour. In small sizes, or for engines of the torpedo-boat type, etc., the demand for oil will rise to considerably higher figures. Of the total amount required as above, some 5 to 10 per cent. will be used for internal lubrication, and the remainder for the various joints, bearings, etc.

(*d*) We have yet to learn on trustworthy evidence that such is the case. In supposed instances the conditions are presumably not the same.

(*e*) Questions of this character cannot be advantageously discussed in a "Query and Answer" column. There is no one routine which is absolutely essential, and the method or routine to be adopted in any individual case would depend in very large measure on the special circumstances, including in particular the style of engine and character of overhaul. Good common sense, with a perfectly clear understanding of just what is to be done, will be found worth far more than any amount of thumb-rule directions in engineering operations of this character.

Q. 224.—Would you kindly inform me, through your question column, what the surface ratio is to the disk area of propellers on tug boats? Also, what relation it bears to the immersed midship section? There seems to be a tendency on the Pacific coast to have the surface ratio high, about .52 to .55 of the disk area, and therefore, as this seems high, I would like your views on this subject.

When delineating a propeller, is it not correct to advance the point *B* beyond the point *A*, the amount of the throw-back of the blade, as *C*, *E*.? A. DE B.

A.—The surface ratio with tug-boat propellers is usually close about .50; sometimes more and sometimes less. This proportion has been worked out as the result of experience with such propellers, and in the general belief that some such area ratio will give all the thrust

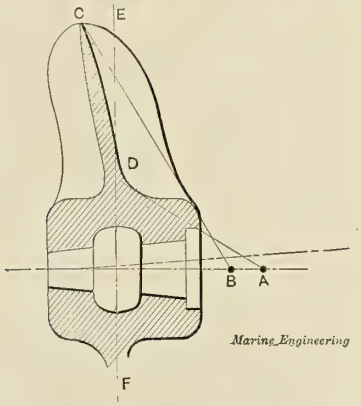


FIG. 1.

that can be expected on the given diameter. Recent experiments on model propellers at Sibley College, Cornell University, have thrown new light on these questions, and have served to show the limit of useful area. In agreement with the indications of theory it was found that this limit is reached earlier with propellers of low pitch ratio than with those of high pitch ratio. With propellers of about 1.1 pitch ratio there is little gain in thrust beyond area ratios of .40 to .45, while with propelers of 1.5 pitch ratio or upward, increase of area brings with it increase of thrust up to area ratios of .55 to .65. In such case, however, the gain for the additional area above .50 ratio is very slight, and in general it may be assumed that a propeller with an area ratio of .50 will give substantially all the thrust which can be expected under usual conditions of operation, and that any further increase in area will not bring with it any essential increase in thrust.

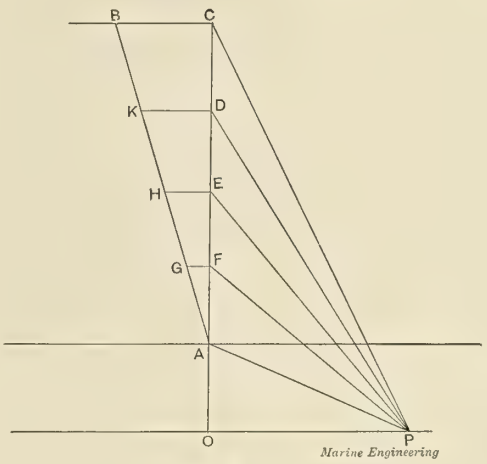


FIG. 2.

The question of the influence of area on efficiency is a further important part of this general problem, but its discussion in detail would take us beyond present limits of space. It will suffice here to state that in general the propeller is not sensitive in efficiency relative to changes in area. That is, at average values of the slip and under average working conditions, considerable changes may be made in area with but slight influence on the efficiency of operation. In particular it has been shown by these experiments that under usual working conditions there is no serious loss in efficiency due to an increase in area up to ratios of about .50, and that, in consequence, such area ratios may be freely employed without incurring any serious loss in the economy of propulsive operation.

Regarding the delineation of a propeller, the methods employed are largely arbitrary, and it should be remembered that the only purpose of the drawing is to give to the pattern maker or founder the information which he will require in order to make the pattern or sweep up the mould in the sand. If we assume that the propeller is to be of uniform pitch but with blades bent back at a certain angle, the simplest method of getting the guide-iron angles is that indicated in Fig. 2. Let *A B* be the center line of the blade tipped back as shown. Then the distance *O P* is laid off on the shaft center line equal to pitch ÷ 6.2832. Then draw *A C* at right angles to the shaft center line and take any series of points *A, F, E, D, C* on this line and draw from them lines to *P*. Then the angles *P A O, P F O, P E O,* etc., will give the guide iron angles for corresponding points on the blade at *A, G, H, K,* and *B*.

So far as your question is concerned, it would be

correct, in laying out the propeller as you have indicated, to make *A B*, Fig 1, equal to *C E*, but this method has the disadvantage that for other points on the blade intermediate between *C* and *D* it is necessary to take likewise intermediate points between *A* and *B*. With the method suggested above, however, all oblique lines are drawn from the same point *P*, and the guide iron angle, or inclination of the blade to the transverse plane, may thus be readily determined for any point on the blade or for any radial distance outward from the axis, in the manner as illustrated in the figure.

Q. 226.—Please advise the best and most prudent way to get grease out of Scotch boilers in both instances: first, where the boiler is very sensitive when sal soda is used; and second, when no inconvenience is suffered from the use of sal soda so far as priming is concerned. E. R.

A.—Instead of getting oil out of your boiler it is far better to keep it from getting in. If, however, oil does enter a boiler in any considerable amount, serious trouble is liable to result, and some means must be employed to minimize the danger. The function of soda is to form a combination with oil which does not adhere to the heating surfaces and which is not likely to produce the bad results due to oil alone. In particular is this the case with animal oils, which with soda form a soap which is soluble in the water of the boiler, and thus does no further damage. In modern practice, however, it is rare to get animal oils into the boilers, because there is danger, if soda is not present, of the separation of the oil into a fatty acid and glycerine, the former of which may attack the plates of the boiler with serious corrosive results. Due to this well-known fact modern internal lubricants are entirely of mineral oil which does not break up in this way, and the oil finding its way into modern steam boilers is therefore of this character.

Where a boiler is tender as regards foaming, soda may tend to aggravate this condition, and it may be necessary to discontinue its use. In such case the best policy would be to install an oil filter and keep the oil out of the boilers entirely, keeping careful watch by timely inspection as to the internal condition in this respect. In any case, as noted at the start, an oil filter is the best means of dealing with oil in feed water. It is here, as elsewhere, "prevention is better than cure."

A.—229. In answering this question in the July number, the authority from which Fairbairn's tests are taken, should be the Philosophical Transactions of the Royal Society of London of 1858. We are indebted to Mr. P. K. Thurston for calling our attention to this oversight.

Q. 230.—Through your Q. and A. column will you please answer, or at least modify, the following problem, to conform to good, current practice? It is desired to ascertain the proper size of boiler, with necessary grate and heating surface, for a fore-and-aft compound-condensing marine engine, 12 and 26 inches by 12 inches, cutting off at 8 inches in the H. P. cylinder and making 200 R. P. M. While it may not be the most economical cut-off to use on such a machine, it is desired to compute boiler dimensions large enough to sustain this cut-off. All figures are to be based on natural draft and a boiler pressure (gage) of 150 pounds.

In "Drawing and Designing for Marine Engineers," by Roberts, Tower Publishing Company, London, there appears this computation, which the writer copies:

Area 12-inch cylinder = 113.1 square inches.
Weight steam at 165 pounds (absolute) = .3714.
Then pounds of steam per hour,

$$\frac{113.1 \times .7854 \times 8 \times .3714 \times 200 \times 2 \times 60}{1{,}728} = 3{,}665.67.$$

For losses in piping, ports, passages, etc., Roberts adds 40 per cent. additional, or $3{,}665.67 \times 1.4 = 5{,}131.938$ pounds of steam per hour. For water to be evaporated for this steam his formula is

$$5{,}131.9 \ \frac{(1{,}224.9 - 140)}{966.1} = 5{,}762.$$

In practice he allows 15 pounds of coal to be burned on each square foot of grate; and 9 pounds of water to be evaporated on each square foot of grate.

Then, from this, grate surface $= \frac{5{,}762}{15 \times 9} = 42.68$ square feet.

Is 40 per cent. really more than necessary, for losses, in good average practice? Can more than 9 pounds of water be evaporated, in ordinary practice, with ordinary coal, or, say, seasoned wood fuel? Eliminating the types of externally fired and the pipe boilers, and being allowed 6 1-2 feet as the maximum athwartship space available for a boiler, what types of boilers could be employed whereby the necessary grate surface could be obtained, with some form of internally-fired boiler? The writer has frequently heard it asserted by steamboat men that on a given width and where a boiler is fired only at one end, the fire-box type will admit of more grate surface than the regular Scotch types. Suppose the problem to be a little further reduced: that the boiler must be of the fire-box type having a circular fire box and fir wood being the fuel; that no grates are to be used, the internal-fired Scotch "wood burners" not requiring or using grates in this section, and the outside shell not to be over 6 1-2 feet diameter, as before. With a 3-inch "water leg," as required by law, what proportion of the internal circumference of the furnace or fire box could be taken as width in figuring the grate surface? A. R. C.

A.—We have looked through the book you mentioned but do not find the same example as you present. However, on page 141, "Drawing and Designing," are given formulas for an 18-inch engine. We presume that you have endeavored to change the formula to your case of a 12-inch engine. In your copy the constant, which we have placed in italics, should be omitted. This is used to determine the area of the cylinder when the diameter is given, and you have already found the area. The area of a cylinder = the diameter^2 × .7854, or the radius^2 × 3.1416. This correction will make considerable change, and your figure for the pounds of steam per hour will be 4667. In carrying this correction through the other steps of the example, the grate surface should be 54 1-3 square feet.

In looking carefully over your example we beg to suggest that before using a formula you satisfy yourself what each figure represents. This is quite a general mistake and ofttimes leads to serious blunders. You state "weight of steam at 165 pounds absolute"; this should properly be stated as weight of one cubic foot of steam at 165 pounds absolute. Again, the formula for water evaporated should be understood before using. It means that the feed water enters the boiler at 140 degrees. This formula is simply for reducing the steam evaporated to a standard basis; that is, the water at 212 degrees evaporated into steam. The fractional part of the expression is called the "factor of evaporation," and while it may be calculated for each and every case, it will be found in tables dealing with steam. You have quoted your authority inaccurately concerning the grate surface, and the expression should read, " 9 pounds of water evaporated *per pound of fuel.*"

Now, concerning the second part of your query: 40 per cent. loss in piping, port passages, etc., is excessive. It probably includes steam used for auxiliaries such as steam pumps and air pumps. While 9 pounds is not an excessive evaporation per pound of coal, it is good practice, but the heating value of coal is much greater than wood, even when the wood is seasoned. Roughly, 2 1-4 pounds of dry wood should evaporate the same amount of steam as one pound of the average quality of soft coal. The contention that the fire-box type of boiler will give more grate surface per foot width of boiler than the Scotch type is very true. The most efficient boiler to suit your conditions was described on page 480 of the September, 1903, issue of Marine Engineering. In it corrugated furnaces are used, but placed inside water drums only slightly larger in diameter than the furnace. But the space between the two shells is connected at the front and back with a large drum above. This permits of large grate surface per foot width, good circulation, and easy steaming. We do not exactly understand your last statement with reference to circumference of furnaces in figuring the grate surface. Presuming that you intended to use the word "diameter" in place of "circumference" would state that the diameter for calculating grate surface should be the least inside diameter.

From the nature of your question it appears to us that you are desirous of getting better posted on marine-engine design, and we would, therefore, heartily suggest that you take up and study some of the standard books on this subject.

Q. 231.—Will you be so kind as to solve the following example in your magazine:

A propeller at 100 revolutions and 20 per cent. slip gives a speed of 18 knots per hour. What will be the speed at 120 revolutions per minute and 25 per cent. slip? C. E. P.

A.—The speed of a ship may be determined by the revolutions of the engine, pitch of the propeller, and the slip. By pitch is meant the longitudinal distance which the propeller would travel in one revolution were it working on a smooth unyielding surface, such as a nut.

Your problem may be solved either by first determining the pitch from the first statement, using that to determine the speed in the final question, or by a simpler and surer method depending upon the ratio of the different factors.

Let us explain the problem fully by the first method: 1 nautical mile = 6,080 feet. Therefore, at a rate of 18 knots, the vessel has traveled 109,440 feet in one hour, or 1,824 feet in 1 minute. Now, while the ship has gone this distance, the propeller has gone (figuratively) a distance = 100 ÷ (100—20) = 1.25 this amount, or 2,280 feet. In one minute the propeller made 100 revolutions and therefore the pitch of the wheel is 2,280 ÷ 100 = 22.8 feet. At a slip of 25 per cent. the speed of propeller is 100 ÷ (100—25) = 1.33 times speed of boat, and at 120 revolutions, speed of boat is,

$$\frac{22.8 \times 120 \times 60}{6{,}080 \times 1.33} = 20.3 \text{ knots.}$$

The shortest method by means of ratio or proportion is based upon the fact that the speed is directly proportional to the revolutions and inversely proportional to the slip. Letting x be the required speed then:

$$18 : x = \frac{100}{1.25} : \frac{120}{1.33};$$

$$\text{Therefore, } x = 18 \times \frac{120}{1.33} \times \frac{1.25}{100} = 20.3 \text{ knots.}$$

Q. 232.—Will you please inform me how I can work out the horse power of a Scotch boiler? Also, explain about the different kinds of tonnage to which a ship is subject and the definition of same? E. S. A.

A.—The horse power of a boiler may be expressed in terms "boiler horse power," the unit being 34.5 pounds of water evaporated from and at 212 degrees Fahrenheit into steam, or it may be stated in terms of indicated horse power of the engine. On board ship the latter method is generally adopted. The power of the boiler depends on the amount of grate surface and the amount of heating surface in the boiler, the other elements being given due consideration of course. In order to produce steam coal must be burned, and, therefore, the area of the grates is the primary factor determining the boiler power. With good natural draft every square foot of grate should give from 7 1-2 to 10 indicated horse power at the engine. The heating surface is so proportioned that the total surface of the tubes, combustion chamber, and effective surface of the furnaces should aggregate 30 to 40 times the grate surface. In good practice 1 I. H. P. should be produced on 2 1-2 or 3 square feet of heating surface.

While strictly speaking there are but two different kinds of tonnage of a ship, the gross tons and the net or registered tons, the dead weight carrying capacity and the displacement are ofttimes confused. The gross tonnage is the capacity measurement of the vessel expressed in tons of 100 cubic feet each. It is found by multiplying the length at the load line, measured from the front of the stem to the back of the stern post, by the extreme breadth of the outside of the plating by the depth from the upper deck amidships to the top of the keel. Each of these dimensions is to be expresed in feet, and the product is to be multiplied by a factor varying from .6 for high-speed steamers and sailing ships to .8 in cargo steamers, and the result divided by 100. To this are to be added spaces under tonnage deck, spaces between tonnage and uppermost deck, and all closed-in spaces, such as poop, forecastle, officers' cabins, cargoes, deck houses, wheel houses, and other closed-in spaces employed for working the ship. Certain deductions are permitted from this total, which are: berth accommodations for the crew in the forecastle or elsewhere, not including spaces for stewards and passenger's servants, berthing accommodation for the officers, except the captain, galleys used exclusively for the crew, and closed-in spaces above the uppermost deck employed for working the ship. In none of these spaces must cargo be carried or passengers berthed, and the total deduction under all these heads must not exceed 5 per cent. of the gross tonnage.

The net tonnage allows certain other reductions necessary for the working of machinery in steamships, which include the engine and boiler-room spaces, and the casing or hatches of these two compartments, and shaft trunks in screw steamers. The sum of these volumes in cubic feet divided by 100 gives the tonnage in machinery space. If this tonnage in screw steamers is above 13 per cent. of the gross tonnage and under 20 per cent., the total

deduction permitted for machinery in coal space is 32 per cent. of the gross tonnage. In the paddle steamers if the measured space has a tonnage of over 20 per cent. and under 30 per cent. of the gross tonnage, the total deduction permitted is 37 per cent. Should the machinery space fall below 13 per cent. or above 20 per cent. of the gross tonnage the deduction from the gross tonnage to be made is to be 50 per cent. more than the measured space in paddle steamers and 75 per cent. in screw steamers.

The above are the rules as laid down for international tonnage and generally accepted by all the maritime nations. The Suez canal dues are fixed, however, on a somewhat different basis of tonnage measurement.

The displacement is the exact weight of the ship measured in tons, and it generally is stated for load conditions.

The dead weight carrying capacity is the number of tons of cargo and coal which the ship will carry at load draft. Another way of expressing it is the tons required to lower the vessel when at light draft with bunkers and cargo spaces empty, to load draft mark.

Q. 234.—Will you kindly tell me how many expansions there are in a marine compound engine? Also, what is meant by expansion? and oblige, READER.

A.—We will take your second query first.

By expansion is meant the number of times that the steam expands from the point of cut-off in the high-pressure cylinder until it is exhausted from the low-pressure cylinder. It is evident that when the steam port is closed the steam increases in volume during the rest of the stroke in the high-pressures and continues expanding in the following cylinders. The volumes of the cylinders vary as the square of the diameter, the stroke, of course, being the same. In a compound, the ratio of the diameters of the high and low cylinders is about as 1 to 2, or the ratio of the volumes as 1 to 4; in a triple-expansion engine the ratio of the volumes of the high to the low pressure is as 1 is to 7 or 8. Now, if cut-off takes place at two-thirds of the stroke, the total number of expansions in a compound will be about $4 \div 2\text{-}3 = 6$; in a triple about 11 or 12.

Q. 235.—An analysis of the interesting race between the *Kanawha* and *Hauoli*, given in your July number, would seem to indicate that the *Hauoli* was improperly fitted to her propeller.

It will be observed that the 24-inch stroke engine of the *Kanawha* managed to make 305 revolutions, or 1,220 feet piston speed, with propellers of 9-feet pitch.

On the other hand, with the same steam pressure and 3 inches shorter stroke, the *Hauoli* was only able to make 290 revolutions, or 1,015 feet piston speed, because her single propeller was 9 feet 6 inches pitch.

Is it not safe to assume that if the *Hauoli* propeller had been 8 feet, or 8 feet 6 inches pitch, the race would have turned out differently? H. S. W.

A.—Since the July issue went to press we have been able to gather the exact data of the *Hauoli's* performance in the race with the *Kanawha*, through the courtesy of the designer of the former, Mr. H. J. Gielow. There is also a correction in the pitch of the wheel as stated in table below.

While you assume that a different propeller on the *Hauoli* would have given different results, doubtless is true; the same would also be true of the *Kanawha*. You have taken it up from the wrong point. An engine may be so designed that although she runs at less piston speed, it will be of greater power than a second engine of greater piston speed. It is possible to design two propellers to give the same efficiency, one running at high revolutions and the other at low revolutions, to drive the boats at the same speed.

For purposes of comparison we repeat some of the data stated in the July issue, and have added thereto the pitch ratio, the apparent slip, and the probable true slip calculated from an assumed wake factor. This true slip is in both cases excessive, and shows that the propellers were running at low efficiency and were doubtless not designed for the high revolutions attained on the race; as seen the probable true slip greatly exceeds that of the calculated true slip which may safely be assumed for these propellers.

	KANAWHA.	HANOULI.
ENGINES:	Two triple.	One 4-cyl. triple.
Cylinder diams.,	14 1-2, 24, 42 ins.	17, 26 1-2, 30, 30.
Stroke,	24 ins.	21 ins.
Revs. average,	305.	302.
Piston speed,	1,220 ft.	1,057 ft.
PROPELLERS:	Two, 4 blades.	One, 3 blades.
Pitch,	9.0 ft.	9.2 ft.
Diameter,	7.3 "	6.7 "
Pitch ratio,	1.23.	1.37.
Speed of ship,	19.9 knots.	19.53 knots.
Apparent slip,	26.5 per cent.	28.8 per cent.
Wake factor, assumed,	6 " "	13 " "
Calculated true slip for maximum efficiency,	20 " "	21.2 " "
True slip, actual,	30.9 " "	38.1 " "

Q. 236.—I would be much obliged if you would state in your next issue of MARINE ENGINEERING what are Tchebycheff's rules (1) of two ordinates, and (2) of three ordinates for the spacing of ordinates for the calculation of a ship's displacement, center of buoyance, and stability? These rules I have not been able to find in the technical text books. A. J. C. R.

A.—Tchebycheff's is an approximate rule for ascertaining the area of an irregular surface. In most of the rules ordinates are laid off at equal distances apart and their values are multiplied by special coefficients. The products of all ordinates are added and the sum multiplied by the distance between the ordinates; the result is the area. Now, in the Tchebycheff rule, the end ordinates are unequally spaced so as to require no special multipliers.

You will find this and other rules for integration stated in Professor Peabody's *Naval Architecture*.

For a discussion of these rules we refer you to the paper read before the Northeast Coast Institution of Engineers and Shipbuilders by Mr. F. H. Alexander and printed in volume xix., part 5 and 9 and volume xx., part 1. The address of the secretary is 4 St. Nicholas building, Newcastle-on-Tyne.

Q. 237.—Would you kindly tell me the proper diameter of the paddle wheels, with width and depth of buckets, for a small boat of 20-feet length, 4-feet beam, and 1-foot draft? Also if you know of some book telling about stern and side paddle-wheel boats. Do you know any directions for making a planimeter? S. W. W.

A.—In the absence of full particulars of your engine and the speed desired, we cannot work out your problem. but quote the following formula from *Seaton's Handbook:*

Let K = speed of vessel in knots.
S = percentage of slip, say 25 per cent.
R = intended number of revolutions per minute.

Then diameter of wheel $= \frac{K\ (100 + S)}{314 \times R}$,

number of floats $= \frac{60}{\sqrt{R}}$,

and area of one float $= \frac{\text{I. H. P.}}{D} \times .2$.

The breadth of the float should be about one-fourth of the length and the immersion should be about one-sixth of the breadth. We would refer you to the Handbook above mentioned for further rules and information.

A little book published by H. S. H. Shaw on the planimeter gives a general explanation of this instrument.

Heating Feed Water.

Editor Marine Engineering:

Referring to Query No. 195, page 138, in your March issue, and correspondence on page 296 in your June number, relating to feed-water heating, I have to point out that in heating feed water by auxiliary exhausts in a tubular feed heater, its temperature will hardly be raised more than 20 degrees (say from 120 degrees to 140 degrees), as the quantity of the exhausts must necessarily be much smaller than that of the feed water, and only the "sensible" heat of the former is transferred to the latter.

By using a heater with live steam injection, such as "Weir's," both the sensible and latent heat of the steam is transferred to the feed water; hence a small quantity of steam will heat the fed water to a high heat (200 to 240 degrees). The live steam can be taken from the low-pressure receiver, where it has already done work in the preceding cylinders. This is very ably set forth in an article by Professor A. C. Elliott, in London *Engineering*, vol. 59, pages 63, 97, and 191.

That the efficiency of the boiler will be better, with feed heated to such high temperature, is evident, and the unequal expansion and contraction of boilers so destructive to riveted joints and other parts will also be avoided. John Haug.

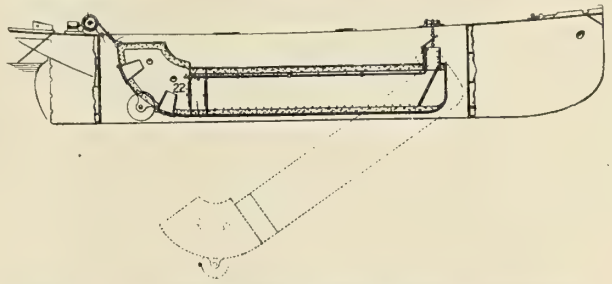
We fully agree with Mr. Haug in his above comments, except his first statement that only sensible heat of the steam is transferred to the feed water in a contact heater. This is a mistake, for it is impossible to remove the sensible heat of steam without partially condensing it or lowering the pressure, and in lowering the pressure from say 8 to 4 pounds, which is an outside figure, the temperature would be reduced but 10 degrees, a drop which would not correspond to the increase in the feed temperature. What does take place in a feed-water heater is exactly similar to that in a condenser. It is known to all that to condense steam the latent and part of the sensible heat is removed, which is the action that takes place in the condenser. Now, the transfer of heat from the steam to the water will not take place as rapidly or as efficiently when said heat has to pass through an iron surface as when the steam and water are brought into direct contact. It is for this reason that the efficiency of the surface heater is so much lower than a direct-contact heater. The best practice in high-pressure plants embodies now the use of the multiple-stage heater for reasons stated by Mr. Haug.

SELECTED MARINE PATENTS.

36,958. STEERING WHEEL. ALLEN W. HOLMES AND HIRAM C. HOLMES, MIDDLETOWN, CONN.

Claim.—The ornamental design for a steering wheel. One claim.

760,457. WORKING VESSEL. SIMON LAKE, BRIDGEPORT, CONN.



Claim.—2. A normally closed tubular structure permanently ballasted sufficiently to destroy buoyancy and having at one end a hatch upon the upper side and at the opposite end a diver's chamber or compartment with a bottom door for establishing communication with the exterior, and provided upon its exterior at both ends with means whereby it may be supported by external means at varying angles with the surface of the water. Seven claims.

760,518. PROPELLING SHIPS. ERNST BOHN, BERLINCHIN, IN NEUMARK, GERMANY. One claim.

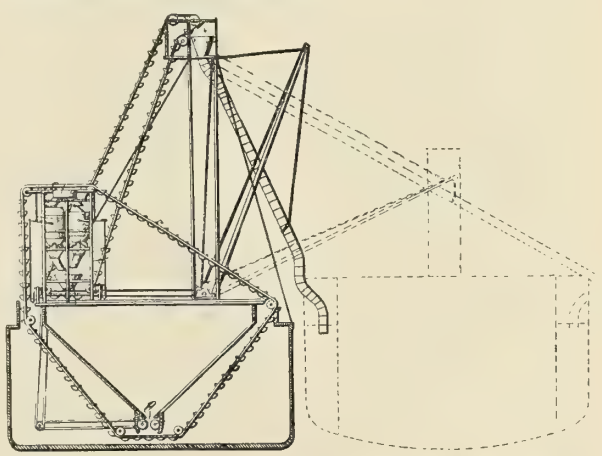
760,535. APPARATUS FOR RAISING SUNKEN VESSELS. DAVID C. GROVES, DUNEDIN, AND ALBERT R. STANTON, SOUTH DUNEDEN, NEW ZEALAND.

Claim.—2. Apparatus for the purpose indicated comprising in combination a tube secured to a vessel and communicating with the interior thereof, superposed independently actuated valves within the tube, means between the valves for breaking a receptacle for calcium carbid within the tube, and a pipe fixed to the vessel and projecting into the interior thereof for the discharge of water therefrom. Two claims.

760,754. SECTIONAL SHELL. GEORGE H. POOR, CHICAGO, ILL. Four claims.

760,758. BOAT PROPELLER. CHARLES F. RITCHEL, BRIDGEPORT, CONN. Four claims.

760,934. APPARATUS FOR COALING BOATS. HENRY D. STEARNS, NEW ORLEANS, LA.



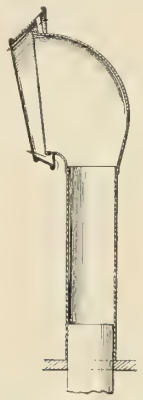
Claim.—Apparatus and means for coaling boats, consisting of the combination with a coal barge divided into separate bins, of a conveyer extending down into the barge and under the said bins, a weighing machine on the barge, located adapted for receiving the elevated coal, a second conveyer arranged for conveying coal from the weighing machine to an elevated position, a chute into which the weighed and elevated coal is delivered, a beam, windlass, and ropes whereby the said chute is adjustably supported, crushers between the lower conveyer and outlet openings in the said bins, a source of power on the barge, shafting and suitable connections through which driving power is conveyed to the said windlass, elevators and crushers, and means whereby the driving power may be cut off. One claim.

761,115. CENTER BOARD. CLAUDE B. WAINEWRIGHT, VANCOUVER, CANADA.

761,620. SHIP'S COWL. CHARLES A. WITHERS, AUGUSTA, GA.

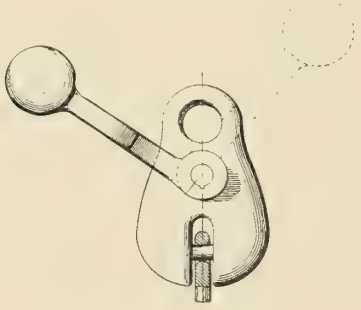
Claim.—1. A ship's cowl comprising an upper section forming a mouth portion, and a collar surrounding and connected to the upper end of said upper section, said collar gradually increasing in width upwardly, said collar projecting inwardly at an inclination, the inclination of the upper portion of the collar being greater than the lower portion, the upper portion of the said collar projecting over the mouth of said upper section, said col-

lar further projecting away from the mouth of said upper section and said collar in connection with said upper section forming an air passage for detecting the air across the mouth of said upper section. Two claims.



761,630. RECORDER FOR BELL BUOYS. JOHN A. FAIRBANKS, CAMBRIDGE, MASS. One claim.

761,809. DETACHING DEVICE FOR LIFE BOATS. ANTHONEY N. ANDERSON, JACKSONVILLE, FLA.



Claim.—2. A detaching device, comprising a block having a segmental recess and a boltway, a locking bolt in the latter, an angularly-movable arm in the segmental recess connected to the bolt to actuate the same, a pivot pin in said arm connected thereto for partial revolution independently thereof, and a weighted lever attached to the said pivot pin. Two claims.

761,835. BOAT. JOHN P. HICKEY, WASHINGTON, D. C. One claim.

762,040. ELECTRICAL CONTACT MEANS FOR SHIPS' COMPASSES. BERNHARD FREESE, DELMENHORST, GERMANY. Four claims.

762,134. CURRENT MOTOR. CHARLES O. BURCHIM, SIOUX CITY, IOWA. Twelve claims.

762,242. ANCHOR. CHAS. MITCHELL, SOUTHAMPTOM, ENGLAND.

Claim.—An anchor of the character described, composed of a shank having a ball formation at one end, an oscillating or turnable head mounted thereon, and composed of an annular piece and a socket piece secured to said annular piece, said annular piece being provided with flukes and with webs. One claim.

762,498. VENTILATOR FOR SUBMARINE BOATS. LAWRENCE Y. SPEARS, GREENPORT, N. Y.

Claim.—1. A submarine or submergible boat, having a ventilator pipe extending upward through its hull, said pipe being provided interiorly of the boat with means for preventing the influx of water therethrough and exteriorly of the boat with a hinge joint, and means operatable from the interior of the boat for folding down and erecting the ventilating pipe.

2. A submarine or submergible boat, having an upright ventilator pipe extending through the hull or shell of the boat and having a hinge joint exteriorly to the boat, a cut-off valve in said pipe interiorly of the boat for closing the passage through said pipe, a toothed segment on the pin of the hinge joint, an arbor extending upward through the hull of the boat, a worm on said arbor and gearing with said segment, and means inside of the boat for rotating said arbor. Two claims.

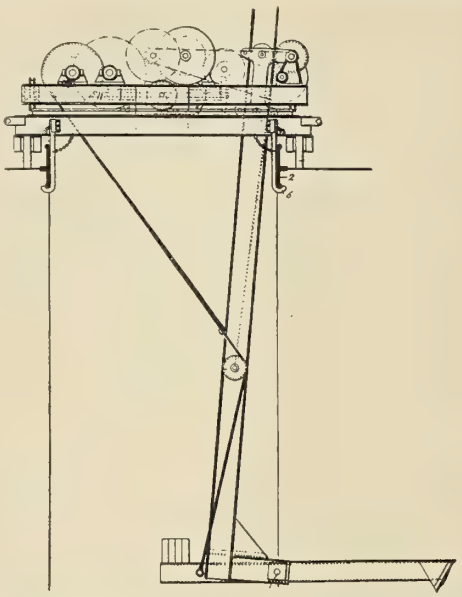
762,687. MEANS FOR PROPELLING SHIPS. WILLIAM COCHRANE, LONDON, ENG. Three claims.

762,710. GROUND ANCHOR. GEORGE HALL, LIMA, OHIO. Four claims.

762,736. GOVERNOR FOR MARINE ENGINES. JOHANNES MATTHIESEN, DARMSTADT, GERMANY. Four claims.

762,785. MECHANISM FOR GATHERING BULK CARGOES BENEATH HATCHES. CHARLES H. WELLMAN AND JAMES E. A. MOORE, CLEVELAND, OHIO.

Claim.—1. In mechanism for gathering bulk cargo beneath a hatch, the combination of a structure mounted over the hatch,



with a beam having a bracket pivotally mounted upon said structure so as to swing laterally, said beam extending down into the hold and being provided at its lower end with a hoe or scraper. Sixteen claims.

762,790. MEANS FOR WORKING SHIPS. WILLIAM WILLIAMS, OAKLAND, CAL.

Claim.—10. The combination, with the masts of a ship, of yards suspended therefrom, sleeves revoluble upon the yards between the center and ends thereof, sails attached at their upper edges to the sleeves, means for revolving the sleeves to furl the sails, means for extending the lower edges of the sails and connecting them with the yard below when set, carriers and rollers carried thereby, said rollers engaging the inner edges of the sails, and vertical guides upon which said carriers are slidable in unison with the furling and unfurling of the sails. Thirteen claims.

762,842. GROUND ANCHOR. ROBERT H. POLK, BIRMINGHAM, ALA. Eleven claims.

PERSONALS.

Professor W. F. Durand, head of the school of marine engineering at Cornell, and acting-director of Sibley College, has accepted the chair of mechanical engineering at the Leland-Stanford University of California.

George F. Johnson, formerly with the Pacific Coast Machinery Company, Seattle, Wash., has removed to Dawson, Yukon Territory.

J. August Reeves, who has been connected with the launch business for many years, has accepted the position of superintendent and assistant manager of the Western Launch and Gas Engine Works, Mishawaka, Ind.

As a result of the competition for architecture for the United Engineering building, Herbert D. Hale, of Boston, and Henry G. Morse, of New York, as associate, were chosen. The successful competitors for the Engineers' club are Whitfield and King, of New York.

Hon. Paul Morton, vice-president of the Atchison, Topeka and Santa Fé Railroad, has been appointed Secretary of the Navy to succeed Hon. William H. Moody, who is now Attorney-General. Secretary Morton is the eldest son of the late Hon. J. S. Morton, Secretary of Agriculture in Cleveland's second administration, and is well known among western railroad managers and in the republican party.

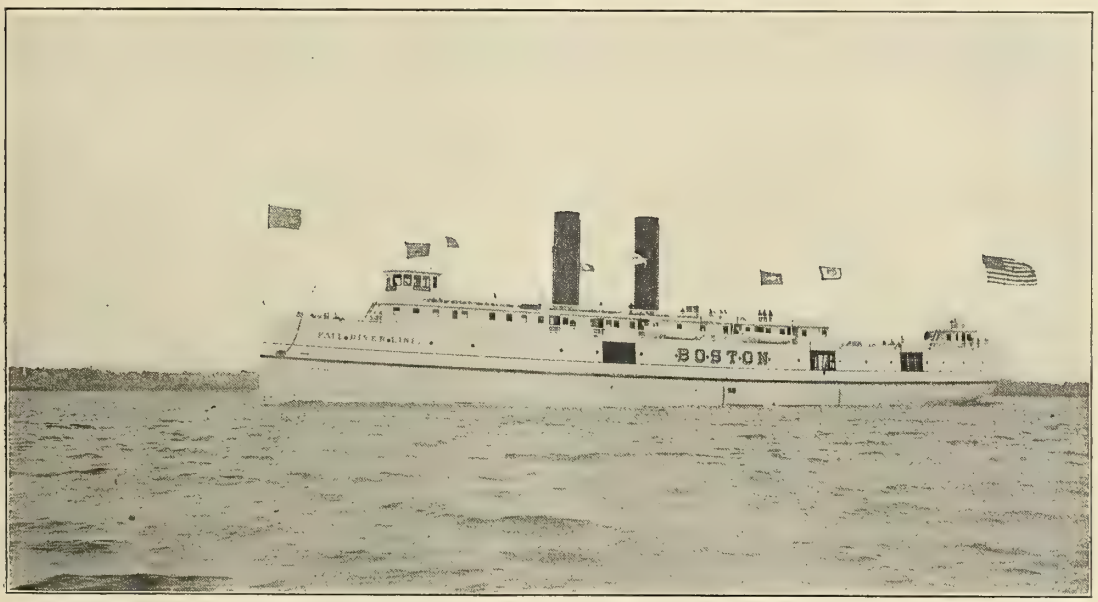
INDEXED

Marine Engineering

Vol. IX. SEPTEMBER, 1904. No. 9.

NEW TWIN-SCREW FREIGHT STEAMER BOSTON OF THE FALL RIVER LINE.

There recently appeared on the waters of New York a steamer which has attracted much attention, owing to the fact that, although built for freight service, she is able to steam at 18 knots speed. This vessel, the *Boston,* of the Fall River line, was built by the Fore River Ship and Engine Company, Quincy, Mass., for large carrying capacity of package freight on the main deck and in the forward and after holds. Her propelling machinery consists of two sets of triple-expansion engines of 5,500 horse power and 8 single-end Scotch boilers. The quarters for officers and crew are arranged on the promenade deck.



FAST TWIN-SCREW FREIGHT STEAMER BOSTON, OF THE FALL RIVER LINE.

The general dimensions of hull and machinery will be found in the accompanying data card. The hull construction is somewhat unusual. Throughout the machinery space extends a double bottom of bracket plate and longitudinal system. The double hull is 3 feet deep at center, and extends above keel at sides amidships. This double bottom proper is about 108 feet long and does not extend beyond the machinery space, but the extension of the margin plate forms a water tight deck, from the forward boiler room bulkhead to collision bulkhead, and from aft engine room bulkhead to a bulkhead located about 20 feet from stern post.

The longitudinals, 13 in number, including center keelson and margin plate, are built of continuous plates, lightened with holes where not water tight, and with manholes in proper position to allow the entire inside of double bottom to be inspected, cleaned and painted. Extra longitudinals under engine are so located that holding-down bolts for engine pass through reverse angles on top of longitudinals. The center keelson and margin plate are water tight. The double bottom is also divided into water-tight compartments by water-tight floors under boilers and engine. The space under water tight deck is divided into compartments by bulkheads, extending from frame to water tight deck, making two intermediate bulkheads forward and two aft of machinery space. The center keelson and stringers have double angles, top and bottom. All other longitudinals, except margin plates, have single angles in short pieces between frames and reverse frames, except the longitudinals that are located in engine compartment, which longtitudinals have double angles between reverse frames. The top edge of margin plate is flanged, and the outer edge joined to bilge plate by continuous angles. Throughout the vessel all frame angles are continuous from center keelson to main deck. The junction of margin plate and outside plate is made

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water tight by stapling. Reverse bars are continuous from main deck to margin plate, and also from margin plate to center keelson. At ends of hull beyond the double bottom, reverse bars are continuous from center keelson to main deck.

Belt frames are fitted on every water tight floor and on short bulkheads at water-tight deck. Similar belt frames are also fitted half way between these points, except in engine and boiler compartments, where belt frames are located. Floors are fitted on every frame in engine compartment and on every other frame in boiler compartment; gusset plates on every frame at center keelson and margin plates, fastened by double vertical angles; single vertical angles are fitted to longitudinals, joining reverse bars and frames intermediate between the bracket floors. Forward and aft of double bottom, regular floor plates are fitted. The inclosures for engines, boilers, donkey boilers, smoke pipes, kitchen pipes, and ventilators are built of steel, for the purpose of having a thorough protection against fire.

A heavy yellow pine guard extends entirely around the hull of steamer on a line with the main deck, and outside of this is a white-oak fender piece, with a steel wearing plate.

The arrangement and equipment of the accommodations on the promenade deck are fashioned much after those of the *City of Taunton,* a paddle-wheel freight boat of the company. At the forward end of house on the port side is the captain's room and on the starboard side a spare room with toilet attached. These are entered from a passageway which opens into the captain's dining room, and also has stairs leading to pilot house above. Aft of the dining room is a saloon used for officers' dining room, with state rooms either side for the officers. A large, well-equipped pantry and galley are at the after end. The house around engine and boiler casings is fitted for accommodating the firemen, crew and oilers, all of whom are given well lighted and well ventilated, comfortable quarters. In the next house aft are built ten state rooms, while at the stern is a small deck house in which the wash rooms and toilets are located.

Hand and steam steering wheels are placed in the pilot house, and a Sickles' steering engine is located at the bow below the main deck. The emergency hand gear is on top of wash-room house. Double quadrants are fitted on the rudder stock. A Providence steam capstan and windlass is located on main deck.

The machinery, capable of developing 5,500 horse power at 125 revolutions, consists of two sets of three cylinder, triple expansion engines with cylinders 24, 37, and 63 inches by 42 inches. Piston valves are fitted throughout, one on the high-pressure cylinder and two on each other cylinder, all operated by Stephenson double link gear. Each cylinder with its valve is in one casting, and the three bolted securely together. They are supported on cast iron columns; in the rear columns is incorporated a surface condenser, while the front columns are of circular cross section and tied with cross rods to back columns. The crossheads bear on guides on both front and back columns; the engines turn outboard; tail rods are fitted on all pistons. A direct connected air pump is driven by levers from the low-pressure crosshead. The usual type of horseshoe thrust block is securely braced to engine bed and is fitted for oil and water circulation.

The auxiliaries are in duplicate for each engine and consist of independent centrifugal circulating pumps for condenser, duplex outside packed-plunger Blake feed pumps, and a vertical single cylinder engine for driving Sturtevant ventilation blowers. A Cameron bilge pump, necessary sanitary and fresh water and donkey pumps are also installed.

The electric lighting plant consists of one General Electric 50 k.w. tandem vertical marine set, placed in the port engine room. On upper engine room platform is a large duplex fire and wrecking pump. It will be noticed from the cut on the title page that there are but two cowl ventilators. Air for ventilating the boiler and engine rooms and for carrying on combustion in boilers is drawn down through the broad scoop ventilator at forward end of engine-room hatch, by the two large steam-driven fans already mentioned, and thence distributed through ducts.

The boilers, eight in number, are arranged with axes thwartship and back to back. Thus, there are two fire rooms, one on each side, with four boilers in each. Wing coal bunkers are placed the length of boiler rooms and thus the handling of coal is reduced

MARINE ENGINEERING DATA CARD. SEPTEMBER, 1904.

NAME—Boston.

LAUNCHED—1903.

NATIONALITY—American.

BUILDER—Fore River Ship and Engine Co.

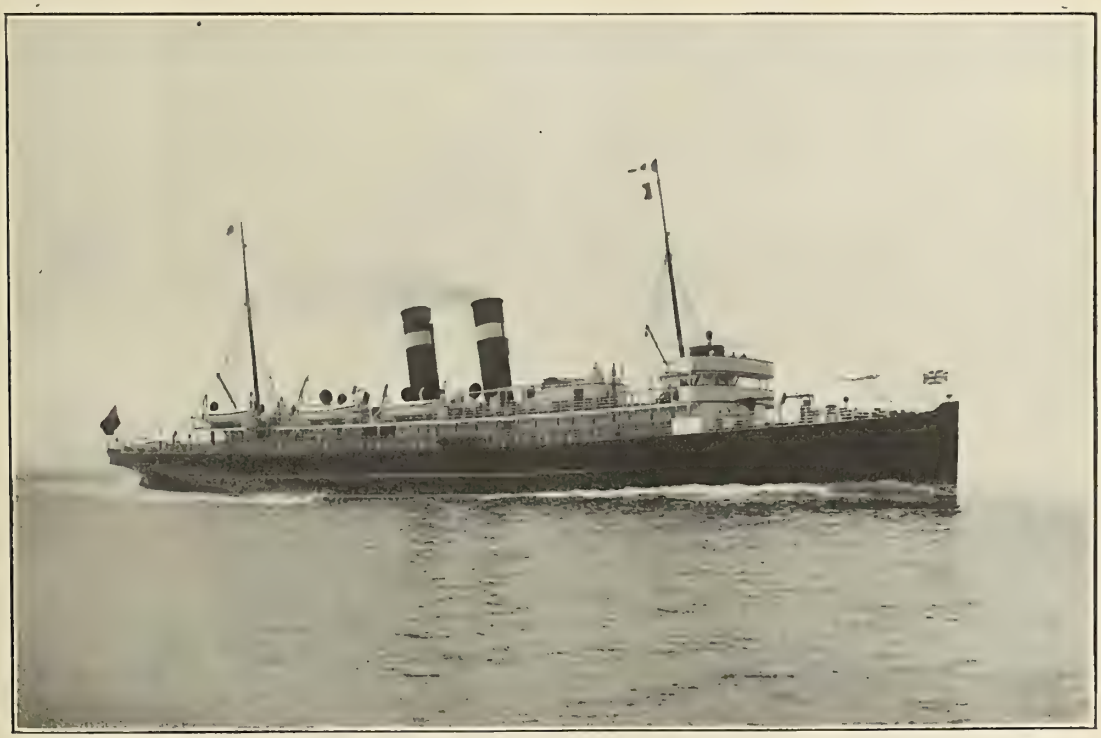
TYPE—Freight steamer.

OWNER—Old Colony Steamboat Co.

Length over all	318 ft. 0 ins.
" molded	291 " 3 "
Breadth, "	60 " 6 "
" over guard	63 " 0 "
Depth, molded	22 " 6 "
Engines:	twin screw
Type	triple expansion, 3-cylinder
Cylinder diams	24, 37, 63
Stroke	42 ins.
Valves	piston
Revolutions	125
I. H. P.	5,500
Boilers:	8 S. E. Scotch
Pressure	184 lbs.
Diameter	14 ft. 2 1-2 ins.
Length, head to head	12 ft.
Furnace	three each
G. S.	600 sq. ft.

to a minimum, as the firemen have but to open the slides directly opposite the furnaces to obtain necessary fuel. Two ash ejectors are placed in each fire room between the first and second and the third and fourth boilers, by means of which it is possible to shovel the ashes from any boiler direct into the adjoining hopper. For ordinary running five or six boilers are all that are necessary.

The arrangement of piping and valves in both engine and boiler rooms is such that either engine may be supplied from any boiler, thus reducing the possibility of a complete breakdown to a minimum. This vessel, the first steamer turned out by the Fore River shipyard, is a well laid out, strongly built, powerful vessel with enough reserve power to make up time against head tides or delay in departure.



THE LATEST TURBINE STEAMER, THE LONDONDERRY, FOR THE IRISH CHANNEL SERVICE.

Turbine Steamers on the Irish Channel.

The progress of the steam turbine for yacht, torpedo boat and channel steamers in England has been rapid since the appearance of the first turbine boat, *The Turbinia,* in 1899. This type of machinery has been specially well-adapted to and shown very good results for the latter class, *i.e,* cross channel vessels.

The Midland Railway Company, operating steamers from Heysham, north of Liverpool, to Ireland, and the Isle of Man, recently decided to construct four new high-speed vessels and the selection of machinery is such that the company will be able to make exhaustive comparative tests for efficiency between the reciprocating engine and the Parson turbine. Two of these vessels, the *Antrim,* built by John Brown & Company, Limited, and the *Donegal,* built by Caird & Company, are fitted with twin screws, triple expansion engines, with cylinders 23, 36, and 42 inches by 30 inches, while the *Londonderry,* turned out from the yard of William Denney & Brothers, and the *Manxmann,* built by Vickers Sons & Maxim, are each to have three shafts, driven by separate turbines. The four vessels are of the same dimensions, namely: length, 330 feet; breadth, 42 feet; depth, to the upper deck, 18 feet. The full load draft of the *Antrim* and *Donegal,* with 300 tons dead weight, 180 first cabin passengers, 80 second cabin passengers, is 13 feet 6 inches, corresponding to about 2600 tons, while due to the lighter weight of the turbine engines, the displacement of the other two vessels is but 2400 tons, corresponding to a draft of 13 feet. The four vessels have the same boilers: two double and one single end Scotch. The steam pressure to be carried on the *Londonderry* is 150 pounds, which is deemed best suited to the turbine, while the steam pressure on the boilers of the other three vessels is 200 pounds. This high pressure was decided on for the *Manxmann* in order that it might be definitely determined whether increased efficiency resulted with increased initial pressure.

Thus, the running of these steamers will permit comparison, not only of relative efficiency of turbine vs. reciprocating engines, but in running two turbines, similar except in the point of initial steam pressure.

The arrangement of the turbines is like that on former vessels fitted by Messrs. Parsons. On the center shaft is the high pressure turbine running at about 600 revolutions, while on each side-shaft is placed a low-pressure machine at 500 revolutions. One item of

saving in weight is in the shafting. The diameter for the reciprocating engine shafting is 12 inches, while that on the turbine is but 8 inches, a saving of about 45 per cent.

But one propeller is now used on each shaft of the turbine steamers in place of two or three, as formerly fitted. This permits of simpler hull construction. Go-astern turbines are placed in the back casings of the low-pressure turbines. As the terminal pressure is most important in turbine efficiency, special vacuum apparatus is installed, that on the *Manxmann* consists of the vacuum augmenter in the form of a steam nozzle placed at the base of the air pump, and in the *Londonderry* of a supplementary Weir air pump. Independent air pumps of the Weir beam type are installed on the other boats.

The elements of design of the propeller best suited to the high revolutions of turbines may not at present be considered final, yet as any comparison between similar ships must be based on speed (such comparison including propeller efficiency in turbine-driven vessels, as it is impossible to indicate the engines) propeller efficiency is a vital question.

Carrying out the plan of the main engines, the electric lighting plant of the *Londonderry* is driven by a Parson's turbine and that on the *Manxmann* by De Leval turbine.

REPORT OF THE BRITISH ADMIRALTY COMMITTEE ON NAVAL BOILERS.

The final report of the committee appointed by the Admiralty to investigate the general subject of boilers best suited for British warships, has been officially issued and is given in full as follows:

1. The Committee on Naval Boilers, appointed by the Lords Commissioners of the Admiralty in September, 1900, having completed their investigations and experimental trials, and being in a position to recommend standard types of boiler for use in H.M. Navy, as requested in their Lordships' letter of February 28, 1901, have the honor to submit their final report.

2. A statement of the work of the Committee up to May, 1902, was given in paragraph 2 of their report of that date. Since then the reboilering of H.M.S. *Medea* with Yarrow large-tube boilers and of H.M.S. *Medusa* with Dürr boilers, together with the necessary machinery alterations, have been completed under the supervision of the Committee, and the boilers of both ships have been thoroughly tested. The results obtained are recorded in a separate report. As requested by their Lordships in their letter S $\frac{16683}{28331}$ of November 19, 1902, the Committee have also carried out a series of trials of the Babcock and Wilcox boilers of H.M.S. *Hermes,* which extended from October 7, 1903, to May 10, 1904 These trials also form the subject of a separate report.

3. The Committee have from time to time reported the results of their investigations, and they have also answered such questions as have been put to them by their Lordships. The reports and other documents which have already been forwarded include:—

(*a*) The interim report forwarded on February 19, 1901.

(*b*) Minutes of the evidence given before the Committee, together with the appendix thereto, forwarded April 26, 1901.

(*c*) Report on the trials of the *Hyacinth, Minerva,* and *Saxonia,* together with a summary of conclusions, forwarded November 27, 1901.

(*d*) Progress report for the year 1901, forwarded December 31, 1904.

(*e*) Report on the relative economy and efficiency of Belleville and cylindrical boilers in commissioned ships; forwarded April 29, 1902.

(*f*) Report of May, 1902, together with the appendix thereto.

(*g*) Report on the trials of the *Seagull, Sheldrake, Espiègle,* and *Fantôme*; forwarded August 5, 1902.

There are now submitted with this report:—

(*h*) Report on the trials of the *Medea* and *Medusa.*

(*i*) Report on the trials of the *Hermes.*

4. The report of May, 1902, was intended to be final as regards the Belleville boiler, and the Committe have since seen no reason to modify the opinion expressed in paragraph 6 of that report—*viz.*, that it is "undesirable to fit any more of this type in His Majesty's Navy."

5. In paragraph 5 of their report of May, 1902, the Committee stated that the experience obtained by them since the date of their report of February, 1901, had confirmed them in the opinion that "the advantages of water-tube boilers for naval purposes are so great, chiefly from a military point of view, that, provided a satisfactory type of water-tube boiler be adopted, it would be more suitable for use in His Majecty's Navy than the cylindrical type of boiler."

In their reports of 1901 and 1902 the Committee expressed the opinion that four different types of water-tube boiler, *viz.*:—

(*a*) Babcock and Wilcox,

(*b*) Niclausse,

(*c*) Dürr, and

(*d*) Yarrow large-tube,

were sufficiently promising to justify their use in His Majesty's Navy in combination with cylindrical boilers. Having concluded their experimental investigations, the Committee are now satified that two of these four types—*viz.*, the Babcock and Wilcox, similar to that tried in the *Hermes* and the Yarrow large-tube, similar to that tried in the *Medea*—are satisfactory, and are suitable for use in battleships and cruisers without cylindrical boilers. In the Babcock and Wilcox boiler the generating tubes are nearly horizontal; in the Yarrow boiler they are nearly vertical. Each type has its particular advantages, and only long experience on general service can show which is, on the whole, the better boiler. For the present the Committee unanimously recommend both types as suitable for naval requirements.

In making these recommendations, the Committee recognize that the upkeep of any water-tube boiler is likely to be heavier than that of the cylindrical boiler; but they are of opinion that the two types they now recommend will cost less for upkeep than the other types of large straight-tube boiler, which they had had under trial.

6. The Committee make these recommendations after investigations and trials carried out under their super-

intendence extending over a period of nearly four years

The ships in which each type of boiler has been tried by the Committee are:—

Cylindrical: H.M.S. *Minerva* and R.M.S. *Saxonia.*

Belleville: H.M.S. *Diadem* and H.M.S. *Hyacinth.*

Babcock and Wilcox: H.M.S. *Sheldrake,* H.M.S. *Espiègle,* and H.M.S. *Hermes.*

Niclausse: H.M.S. *Seagull* and H.M.S. *Fantôme.*

Dürr: H.M.S. *Medusa.*

Yarrow large-tube: H.M.S. *Medea.*

7. Although the Committee have no knowledge of any type of water-tube boiler which is likely to prove more suitable for His Majesty's ships than the two recommended, there are other types which may be considered worthy of trial later on. If any type of boiler is considered, in future, to be of sufficient merit to justify its trial in the Navy, it is recommended that it be fitted in a new vessel not smaller than a second-class cruiser.

8. As in their previous reports, the Committee do not offer any remarks upon the most suitable type of boiler for small vessels of high speed. From the nature of the case, some form of "express" boiler, with small tubes closely pitched, is absolutely necessary, in order to obtain such a ratio of output to weight of boiler as is required in torpedo-boats and destroyers. For small cruisers, however, which have to keep the sea and act with the fleet, it is probable that a boiler such as the Yarrow large-tube would, on the whole, give better results than the "express" types which have hitherto been fitted.

9. In reference to paragraph 3 (*b*) of their Lordships' letter of September 6, 1900, and to the Committee's report of May, 1902, they desire to call attention to the breakdown of the *Hyacinth's* machinery on February 16, 1903, and to the trouble experienced with the bearings in the *Hermes* during the homeward run from Gibraltar, which strengthen the recommendation of the Committee contained in paragraph 13*a* of the report of May, 1902, *viz.,* "They consider it desirable, where practicable, to increase the length of stroke and reduce the number of revolutions per minute as compared with the recent practice in His Majesty's Service."

10. The principal comparative results on which the recommendations of the Committee are based are set forth in the succeeding paragraphs. Full details are given in the separate reports of trials.

11. *Thermal Efficiency of Boilers.*—The full tables which are appended to the Committee's report give the efficiency of each type of boiler under very varied conditions. The results are here summarized:—

The best obtained with the Babcock and Wilcox boilers of the *Hermes* were during the trials of furnace gas baffling, the boilers in the middle boiler room, with vertical baffles and a forced air supply over the fires, giving the high efficiency of 81 per cent. on a 30 hours' trial, when twenty pounds of coal were being burned per square foot of fire grate per hour, and an efficiency of 77.8 per cent. on a 29 hours' trial when burning 27 pounds per square foot, these rates of combustion corresponding to the ordinary rate of steaming and to the full power of the boilers respectively. The boilers of the *Hermes* with the restricted uptake baffling, and without any special air supply over the fires, had a maximum efficiency of 75.8 per cent. on a 12 hours' trial when burning 20.5 pounds per square foot per hour. On three trials of over 24 hours duration each, and when 19 pounds were being burned per square foot per hour, the efficiency was in each case practically 71 per cent. When burning 29 pounds per square foot per hour for seven hours, the efficiency of these boilers was 66.3 per cent.; but the weather during this test was so bad that the trial, which was to have been of eight hours' duration, had to be stopped on account after the seventh hour. During the baffling trials, however, in good weather, an efficiency of 70.3 per cent. was obtained on the 30 hours' trial, when burning 27 pounds per square foot per hour, or practically the full output.

The maximum efficiency of the Yarrow boilers of the *Medea*—viz., 75.7 per cent.—was obtained on a 26 hours' trial when burning 18 pounds per square foot per hour; their efficiency when burning at the maximum rate of combustion—viz., 40 pounds per square foot per hour for eight hours—was 69.5 per cent. On trials of over 24 hours' duration each, burning from 17 pounds to 21 pounds per square foot per hour, the efficiency remained at or over 75 per cent.

The Belleville boilers of the *Hyacinth* had a maximum efficiency of 77.2 per cent. recorded on a 24 1-2 hours' trial, when 16 pounds of coal were being burned per square foot of fire grate per hour. When burning 20 pounds per square foot per hour for 11 hours, the efficiency was 73.3 per cent., and burning 17.4 pounds for 24 hours it was 71.8 per cent. The efficiency of these boilers on an eight hours' trial in fine weather, when burning 27 pounds per square foot per hour, corresponding to the full output of the boiler, was 65 per cent.

The maximum efficiency of the Dürr boilers of the *Medusa* was 64.8 per cent. obtained on an eight hours' trial, when burning 35 pounds per square foot per hour, this being the maximum rate of combustion with these boilers; the efficiency when burning 16 pounds per square foot per hour for 26 hours was 63.8 per cent. On trials of over 24 hours' duration each, and burning 18 pounds and 21 pounds per square foot, the efficiencies were 61.7 per cent. and 60.3 per cent. respectively.

Of the cylindrical boilers tried, those of the *Saxonia* on the only trial made, which was of 13 hours' duration, and on which 20 pounds per square foot per hour was burned, had the high efficiency of 82.3 per cent.

The maximum efficiency obtained with the cylindrical boilers of the *Minerva* was 69.7 per cent., which was recorded on a 25 hours' trial when burning 14 pounds per square foot per hour; on a trial of 8 1-2 hours' duration, with retarders in the plain tubes, and burning 29 pounds per square foot, the efficiency was 68.4 per cent.

In the smaller ships, the maximum efficiency of the Babcock and Wilcox boilers tried was 66 per cent. on a 12 hours' trial, burning 18 pounds per square foot per hour in the *Sheldrake,* and 73.2 per cent. on a nine hours' trial, burning 13 pounds per square foot, in the *Espiègle.* The maximum efficiency obtained by the Niclausse boilers of the *Seagull* was 66.9 per cent. on an eight hours' trial, burning 13 pounds per square foot, and by those of the *Fantôme* 69.8 per cent. on a nine hours' trial, burning 14 pounds per square foot.

12. A noticeable feature in connection with the boiler efficiencies is the improvement in the results obtained with the later boilers of the Babcock and Wilcox type. The earliest of these, fitted in the *Sheldrake* in 1898, showed efficiencies ranging from 66 per cent. to 59.2 per cent.; the boilers fitted in the *Espiègle* in 1901 showed improved efficiencies, ranging from 73.2 per cent. to 63.1 per cent. Those of the *Hermes,* fitted in 1903, show a still further gain in economy, the efficiencies ranging from 75.8 per cent. to 66.3 per cent., and the same boilers, after modification, showed on one occasion the high efficiency of 81 per cent. It is noticed in this connection that the three sets of Babcock and Wilcox boilers tried differ from each other on the arrangement of their heating surface and furnace gas baffling. The boilers of the *Sheldrake* were fitted throughout with tubes 1 13-16 inches in diameter, without any baffles for furnace gases; the boilers of the *Espiègle* were fitted throughout with tubes 3 3-16 inches in diameter, vertical baffles being placed among the tubes, and causing a zigzag flow of the gases; the boilers of the *Hermes* were fitted with two rows of 3 15-16 inches diameter tubes, immediately over the fire, the remainder of the tubes being 1 13-16 inches in diameter, and the baffling of the furnace gases was effected by a restriction of the space for the passage of the gases between the top row of tubes. Those boilers of the *Hermes* which showed the efficiency of 81 per cent. were similar in construction to those last mentioned, but the baffling of the furnace gases was by a vertical system which caused a zigzag flow of the gases over the heating surface, and, in addition, a forced air supply was introduced above the fires. (See "Report on Trials of H.M.S. *Hermes.*")

The arrangement of the heating surface in both the earlier and later boilers of the Niclausse type was the same, and the thermal efficiencies of the two sets of boilers were very similar.

13. *Wetness of Steam.*—As explained in other reports, the wetness of the steam was taken throughout the Committee's trials by means of a Carpenter's calorimeter. Experience in the *Medusa* satisfied the Committee that the results registered by this instrument are trustworthy.

As regards the production of dry steam at all rates of combustion, the Yarrow large-tube and the later Babcock and Wilcox boilers have given the best results.

14. *Loss of Water.*—The loss of feed water with each of the four types of boiler under consideration has been moderate throughout the Committee's trials. In the runs to Gibraltar and back, carried out with the *Medea* and *Medusa,* the loss of water was small, being at the rate of 1.6 and 1.8 tons per 1000 horse-power per day respectively. On the 140 hours' endurance trial of the *Hermes* the loss was 3.8 tons per 1000 horse-power per day.

The loss of water may be expected to be greater in boilers fitted with many doors than in those fitted with but few, and to increase as the doors and joints become worn. In this respect the Yarrow boiler, having only three manhole doors, has an advantage.

15. *Examination and Cleaning of Interiors of Tubes.*—Of the boilers tried by the Committee, the Yarrow boiler can be internally examined and cleaned in the shortest time and with the least amount of labor—to obtain access for such an examination and cleaning it is only necessary to remove three manhole doors. The Babcock and Wilcox type is less easily examined and cleaned—two small doors have to be removed for each tube, and these have to be rejointed after the examination and cleaning have been completed. In order to carry out a thorough examination of the tubes of the Dürr boiler it is necessary to remove a hand-hole door at the front of each tube, the diaphragm washer of the internal tube, the internal tube itself, and the cap-nut at the back end of the generating tube; but in order to carry out a thorough cleaning, it is also necessary to remove the generator tubes from the boiler; after the cleaning is complete, these have to be replaced, and this is a long and tedious process. The work connected with the examination and cleaning of the tubes of Niclausse boilers is very similar to that necessary with the Dürr boiler. Further, the cap-nut at the back end of the Dürr boiler tube permits of each tube being readily emptied, while owing to the back end of Niclausse boilers being inaccessible, some process is necessary to empty the tubes when required, such as blowing the water out of the tube by a special pump and hose.

The necessity for being able to withdraw each of the tubes in a direct line with its axis renders the clear space required for the installation of Dürr and Niclausse boilers considerably more than would be required for boilers of other types. For warships, where the stokehold space is very limited, this must necessarily cause considerable inconvenience in the arrangement of pipes and auxiliary machinery.

16. *External Cleaning of Tubes.*—In both the *Medea* and the *Hermes* it is possible to partially clean the tubes externally, when the fires are alight, by means of air-lances.

The tubes in the *Medea* can be thoroughly cleaned externally when the fires are not alight, as they can be swept in three directions—viz., from the furnace, from the smoke box, and from the front of the boiler. The tubes of the Dürr and Niclausse boilers cannot be so thoroughly cleaned externally in place as those of the *Medea,* the number of rows being greater, and the overlapping of the baffles preventing portions of certain tubes being touched. In the Babcock and Wilcox boilers the tubes can be swept horizontally through side doors fitted to the casings; but as the boilers in the *Hermes* were originally fitted, the sweeping in a vertical direction was difficult. After the alterations of baffling, the sweeping vertically can be carried out, but this necessitates the removal of portions of the baffles. It is to be recognized that any system of baffling among the tubes, however it may improve the circulation of the gases, renders the cleaning of the tubes themselves more difficult.

17. *Bending of Tubes.*—After the *Medusa* had completed her preliminary runs, it was found that all the tubes of the bottom rows had curved upwards in the middle, the maximum bending being 1 1-6 inches, and these tubes were removed and straightened before starting on the Committee's trials. These tubes had to be straightened again in August, 1903, and again at the conclusion of the Committee's trials in February, 1904. When the Committee visted H.M.S. *Berwick* in April,

1904, it was noticed that the tubes of the bottom rows of the boilers (Niclausse type) were bent upwards, and the members were informed that the maximum bending on March 22, 1904, was 5-8 inch. The ship was new in 1903, and only commissioned in December of that year. With the Niclausse, and also with the Dürr boiler, considerable bending of the tubes of the bottom rows must be expected; and it will be necessary to straighten these tubes when the amount of bending exceeds 3-4 inch. This will entail a considerable amount of extra work with these types of boiler, and they will be off service for corresponding periods. The upward bend of the generator tube is often greater than the space between the inner and outer tubes; and as the inner tube, which is only supported at the two ends, remains straight, it is liable to touch the outer tube at some point, thus impeding the circulation of water between them. To prevent this it may be necessary to support the inner tube at the middle of its length as well as at the back end, so that it must bend with the outer tube.

In the case of the Yarrow boilers of the *Medea*, the Committee experimented in six of the boilers with the fire-rows of tubes purposely bent, as described in the report on the trials of the *Medea* and *Medusa*, with the object of overcoming some slight leakages of tube-ends, which showed themselves when working under forced draft. In two boilers the tubes of the fire-rows were left straight. Although these bent slightly in use, no trouble was experienced with them; and, during the later trials, these boilers proved to be as satisfactory, as regards freedom from leakage, as those in which the fire-rows had been put in bent. The Committee have suggested in their letter of December 21, 1903, concerning the Yarrow boilers proposed for H.M.S. *Warrior*, that the tubes of the fire-rows should be bent 1 inch from the straight, and this recommendation they think should apply to future designs.

In the Babcock and Wilcox boilers of the *Hermes*, although some of the tubes of the bottom rows have bent, no leakage of tube-ends has resulted, and it has not been necessary to remove any tubes for straightening or renewal.

18. *Corrosion of Tubes and Wear of Casings and Uptakes.*—In none of the four types of water-tube boiler which were recommended for trial by the Committee has there been any considerable corrosive decay of tubes, and the ordinary wear has been very slight. On the conclusion of the Committee's trials the tubes of the boilers of the *Medea* and *Hermes* had not deteriorated to any appreciable extent. This applies also to the *Medusa*, except that the internal tubes have shown signs of roughening.

In the *Medusa* (Dürr boilers) there was some buckling of the side casings of the boilers, and some of the casing doors at the back of the boilers became warped and burned.

No trouble was experienced in connection with the casings and uptakes of the Yarrow boilers of the *Medea*, and very little with those of the Babcock and Wilcox boilers of the *Hermes*. From the experience of the Committee with the boilers of the *S. S. Martello*, employed on the Atlantic trade for nearly four years, and also from their experience to date with the *Hermes*, it is considered that the durability of the casings and uptakes of Babcock and Wilcox boilers will prove to be satisfactory under the ordinary conditions of naval service.

In the Yarrow boiler the temperature of the furnace gases is considerably reduced before they reach any part of the side casings; and, in consequence of this moderate temperature, the casings and uptakes of the *Medea's* boilers were uninjured on the conclusion of the Committee's trials.

In this respect the Yarrow boiler is superior to the other types of water-tube boiler which have been tried by the Committee.

19. *Liability to Damage from being Forced.*—The makers of the Dürr boilers stated that not more than 35 pounds of coal should be burned per square foot of fire grate per hour in the *Medusa*. The Committee consider that this limitation of the quantity of coal to be burned was prudent, as the overheating and bending of tubes in one of the boilers during the full-power homeward run from Gibraltar were, in the opinion of the Committee, due to the fact that the safe limit had been exceeded. It is also considered that the limitation of the amount of coal to be burned per square foot of grate applies with even greater force to the Niclausse boiler, as the supply of water to the tubes is freer in the case of the Dürr boiler than in that of the Niclausse. As the result of their trials, the Committee find that the Yarrow boiler can be severely forced without danger, and that the Babcock and Wilcox boiler can with safety be forced to the extent shown in the reports.

20. *Skilled Firing Required.*—The satisfactory stoking of water-tube boilers requires a higher degree of skill than that of the cylindrical boilers, and this is more necessary with the large grates of the Dürr, Niclausse, and Babcock and Wilcox boilers than with the smaller grates and better shape of combustion chamber of the Yarrow. The stoking in the *Medea*, *Medusa*, and *Hermes* was good throughout the trials, and towards the end was excellent. Under ordinary service conditions, such good firing can hardly be expected, at least until a vessel has been some time in commission. Good results can, however, be obtained with Yarrow boilers with engine-room complements new to the ship, as shown by the trials to Malta and back, which have been made by the *Medea* since the completion of the Committee's trials with that vessel.

21. *Superheated Steam.*—The Dürr boiler was the only one tried by the Committee which had any arrangements for superheating. It was fitted with complicated directing plates in the steam collector and with superheater tubes. The fittings in the steam collector are undesirable, and they and the superheater tubes will probably require frequent renewal, while the amount of superheat obtained by their use was small, even when the temperature of the funnel gases was abnormally great. The results obtained were not sufficient to enable the Committee to express any opinion as to the value of superheating as applied to naval boilers.

22. *Feeding of the Boilers.*—No trouble has been experienced with the feeding of any of the four types of boilers under consideration. In the *Medea* and *Medusa*

the boilers were fitted with automatic feed-regulators. It was found, however, that these were not sufficiently sensitive in opening and closing (allowing a variation of level of about 6 inches in the gauge-glass); the feed was, therefore, regulated throughout the trials by hand, no trouble being experienced in doing this. For a similar reason the feed was regulated by hand in the *Hermes* during the trials. In the *Medea* the feed regulators were inside the steam collectors, and interfered with the examination and cleaning of the middle rows of tubes. The Committee consider that the balance of advantages rests with the omission of automatic feed regulators in boilers—such as the Yarrow large tube and the Babcock and Wilcox, where there is a fairly large reserve of water in the boiler.

WEIGHTS AND MAXIMUM OUTPUT OF VARIOUS TYPES OF BOILERS

Type of Boiler.	Ship.	Weight of Boiler-Room Installation.	Maximum Output of Steam per hour.	Output of Steam per Hour per Ton of Boiler-Room Weights.	—
		tons.	lb.	lb.	
Cylindrical..	Saxonia....	1,000 (about)	132,600	132.6	
" ..	Minerva...	567	167,100	295	With retarders
" ..	" ...	558	156,200	280	As originally fitted.
Belleville....	Hyacinth ..	454	178,700	394	
Yarrow.....	Medea	330	157,800	478	
Dürr.....	Medusa....	314	158,000	503	
Babcock and Wilcox.	Hermes....	490	200,000	410	With vertical baffles and forced air supply above the fires.
"	"	481	182,300	380	As originally fitted.
"	Sheldrake.	125	43,840	351	
"	Espiégle...	95	24,780	261	
Niclausse	Seagull....	135	48,450	359	
"	Fantôme ..	76.5	22,750	297	

23. *Salt Water.*—The report on the trials of the *Medea* and *Medusa* contains a description of experiments made on the Yarrow and Dürr boilers in regard to their behavior when working with brackish water. These experiments, so far as they went, indicated that neither type of boiler was likely to give trouble from this cause. In the case of the Yarrow boiler this result has been corroborated by the fact that on a recent voyage the *Medea* is reported to have had leaky condenser tubes, and a corresponding density in the boilers, without any bad effect.

24. *Relative Weights.*—In the case of the *Hermes*, the *Medea*, and the *Medusa*, the new boilers were installed without any alterations being made in the stokehold floor spaces. A comparison of weight and maximum output of the boilers gave results tabulated on this page.

25. The Committee are under great obligations to Mr. C. J. Wilson, F.C.S., who has, during the four years of their work, given his valuable personal attention to the analyses of funnel gases and of coal samples without any remuneration. They are also much indebted to Messrs. Thomas Wilson, Sons, and Company, for permission to examine the boilers of the *S. S. Martello*, and to Mr. W. S. Hide, the superintending engineer of that company, for affording the Committee facilities for carrying out the inspections and giving information concerning the results obtained in the running of that vessel.

26. The Committee desire, in conclusion, to place on record their appreciation of the assistance which they have received from their secretaries. Captain Browning, R. N., acted as joint secretary until his appointment to H.M.S. *Ariadne*, in 1902. Engineer-Lieutenant W. H. Wood, R. N., has continued to act as secretary throughout their whole work. The diligence and energy which the latter officer has shown in carrying out his work, his knowledge of the scientific, as well as of the practical, side of marine engineering, and his capacity for dealing both with details and with general organization, have been invaluable to the Committee throughout, and especially in connection with the carrying out of their boiler trials at sea, a work of no little difficulty and complexity; and they desire to bring his services to the favorable notice of their lordships.

(Signed) COMPTON DOMVILE,
(Admiral and Chairman).
JAS. BAIN.
JOHN INGLIS,
ALEX. B. W. KENNEDY,
JOHN LIST,
J. T. MILTON,
JOS. A. SMITH.

WM. H. WOOD, *Secretary.*

Launch of U. S. Armored Cruiser South Dakota.

The second armored cruiser built on the Pacific, the *South Dakota*, was successfully launched at the Union Iron Works, San Francisco, on July 21. The accompanying photograph was taken immediately after the vessel was water borne. The launch was made the occasion of a visit of the governor of South Dakota, and his family, the governor's daughter being selected as the sponsor for the new cruiser.

This ship, which was authorized by Congress, June 7, 1900, was contracted for on January 10, 1901, for $3,750,000, without armor or armament. The vessel was to have been completed in three years from the date of contract, but many delays of one kind or another have been encountered and at the last official report she was but 59 per cent. completed. The keel was laid September 30, 1902.

The *South Dakota* is one of the six similar armored cruisers, with two 8-inch barbette turrets, building for the government. The general dimensions, when the ship is fully equipped, ready for sea with all stores on board and a normal coal supply, are as follows: Length on load water line, 502 feet; extreme breadth, 69 feet 6 1-2 inches; mean draft, 24 feet 1 inch; displacement, 13,680 tons; the full load displacement will be 15,138 tons. The vessel is to be propelled by two sets of twin screw, vertical, triple expansion, four cylinder engines, with maximum estimated horse power of 23,000,

and with this power the ship is contracted to make 22 knots. The cylinder dimensions are as follows: High-pressure, 38 1-2 inches; intermediate, 63 1-2 inches; two low-pressures, 74 inches; the common stroke is 48 inches. Sixteen Babcock and Wilcox boilers, with 1,600 square feet of grate surface and 70,944 square feet of heat surface are to furnish steam for main and auxiliary engines.

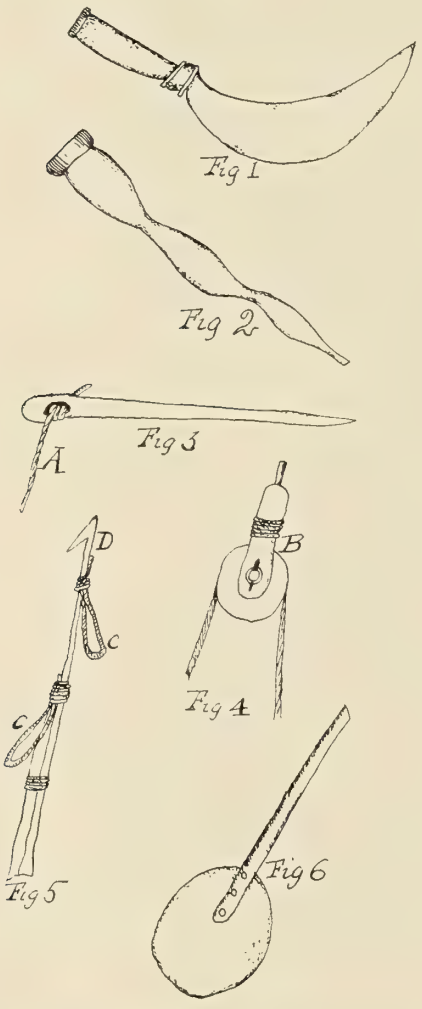
The main battery consists of four 8-inch breach-loading rifles, mounted in two 6 1-2-inch turrets and 6-inch barbettes, one forward and one aft, and fourteen 6-inch rapid fire guns mounted in broadside. The secondary battery is composed of eighteen 3-inch rapid-fire guns, twelve 3-pounders semi-automatic, eight 1-pounder rapid fire, two 3-inch field guns, two machine guns, and six automatic Colt guns. The water line is protected by a belt of armor 6 1-2 inches thick amidships, tapering to 3 inches at the ends, and above this amidships is worked in lighter side armor, protecting the gun battery. The equipment of this cruiser is of the very latest and her complement, when in commission, will include 47 officers and 782 men.

THE UNITED STATES ARMORED CRUISER SOUTH DAKOTA, LAUNCHED FROM THE UNION IRON WORKS.

Filipino Craft and Craftsmen.

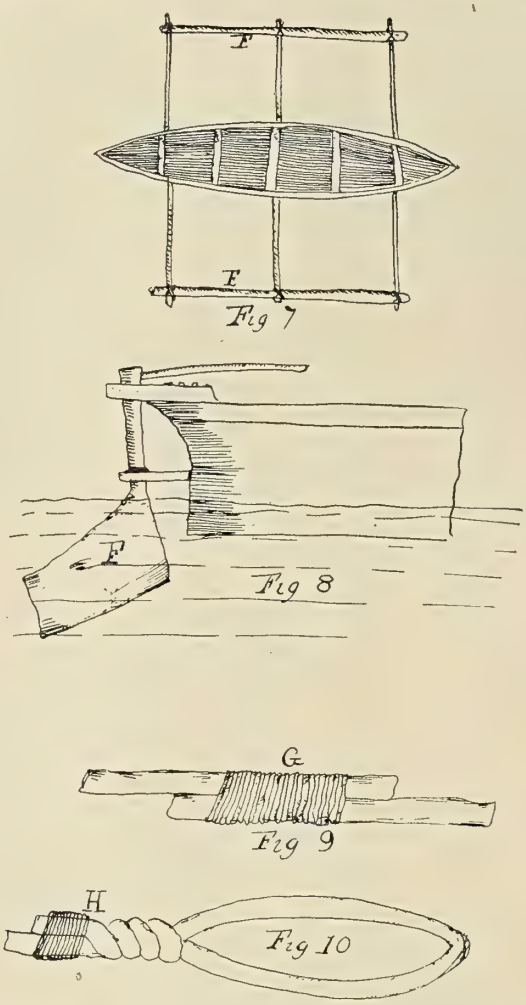
The knife carried in the waist belt of the Filipino boatmen of the southern islands of the archipelago is enough to give the wearer a pirate-like appearance. The blade is large and curved, as represented in Fig. 1, and is used in cutting wood, ropes, meat, and for protective purposes. Another form of tool, often utilized by the native boatmen, as sketched in Fig. 2, is a piece of the so-called "iron-wood" stock of the Isle of Mindanao. The wood is so extremely hard that it is called iron-wood by the American soldiers and sailors. When the wood is ground down to a point by the natives a tool is formed, as in the figure, which is carried in the belt, and is utilized for a multitude of purposes in connection with rope splicing, rigging, punching, spearing, and kindred purposes. The native sailor's needle is exhibited in Fig. 3. Usually the needle shaft is forged by hand from bits of wagon-tire metal, a nail, piece of signal-corps wire, and the like. The needle is coarse and is threaded with hempen stock through quite a liberal-sized hole in the shaft. With this needle the native boatmen sews up skin sail stock, the plaited mattings of bamboo, etc.

Fig. 4 is a drawing of the native type of block and pulley. The wheel itself is usually shaped on a hand-turning affair, very little like a lathe, as we understand lathes. The native has two or three helpers, and considerable time, labor, and chattering are consumed in grinding out a wheel for a pulley. Then the block is made from two pieces, and pinned with wooden pegs, and roped as shown. The wheel shaft is usually hard wood. The rope is inserted at *b*, as shown, and this completes the block.



In Fig. 5 is sketched a queer kind of boat hook. The handle is strong bamboo, while the hook itself is forged from metal and is secured to the wood shaft or pole by binding, as represented. Loops *c*, *c*, are arranged along the hook pole so that when the hook is inserted into anything, and it is desired to haul in, the loops can be grasped in the hands or by other hooks.

Everywhere one sees the little native boats skimming about. If you land by transport in a harbor the native boats assemble quickly to sell you fruit. The boatmen have long poles and will elevate bunches of fruit to you on the upper deck, receiving their pay in a little bag fixed to the pole near the top. The paddles used are spoon-shaped affairs, consisting chiefly of a disk fastened to a handle, about 20 inches in diameter, and shown in Fig. 6. With these three or four natives can propel quite a good-size boat, well freighted with commercial articles, at considerable speed for long distances. The boats are dug-outs, made from hollowing out big tree limbs. A great majority of the boats have outriggers, as represented by the bamboo poles at *e*, *e*, Fig. 7. I have been ferried across deep waters in boats without these outriggers, and have decided to hereafter select the boats with outriggers. The boats without outriggers are just as long and narrow as the others, and unless you aid in keeping them straight by skilfull balancing you may go



over. With the outrigger the boat rarely upsets, and even heavy seas cannot capsize it. The rudders of the average native boats are indeed crude, very large, cumbersome, and deep in the water. Fig. 8 is a drawing of the usual order of rudder; it not only projects back quite a distance, but it droops well into the water, as marked at *f*. The rudder is often one piece of tree stock, the root being the shaft, and is quite powerful.

The manner of propelling the native boats in the canal at Manila is queer. The government lighters are hauled with tugs, but the native freighters depend upon poling to get their craft from point to point through the long city canal from the sea to the interior. Six to ten natives with poles ranging from 30 to 40 feet long, propel the boat by inserting the pole at the head of boat and pressing upon the pole with the shoulder until they reach

the stern, running along a specially arranged bamboo platform on the outside of the boat just above the water line. Very slow progress is made, but it is cheaper than tug hire.

The native craftsmen are great fellows to bind up things. Fig. 9 explains the process of winding pieces of wood together, to make a joint, using hemp cordage as a rule, as at *g*. The natives often splice ropes this

FILIPINOES MAKING ROPE.

way. They frequently make a loop in a rope by lapping over the end and after giving it a few turns about the body piece they bind the two together with cords, as at *h*. This makes a rather feeble connection that may pull apart. Few of the native boatmen understand the art of splicing ropes. They depend almost altogether upon knotting or wrapping ends and binding them. The native boatment usually make homes of their boats and live and die on them.

"A Soldier of the Philippines."

Steaming Powers of the Russian and Japanese Fleets.

In a recent issue of London *Engineer* are given some interesting particulars concerning the steaming capacity of the rival war ships of Russia and Japan, gathered from officers in the far East who are in a position to glean the views of the combatants. These ships, especially those of Japan, which are maintained at long distances from a naval base, have gone through many months of active and severe service. As might be expected not a single ship is now able to steam at its original speed, but in the majority of cases this appears to be due from the absence of docking rather than to machinery and boiler troubles.

Up to the time of her loss the most efficient steamer in the Japanese fleet was the *Hatsuse*. An officer of hers, writing only a few days before that event, mentioned that no defects of any kind had appeared in her boilers or machinery, and her speed loss from foul bottom was very little, about half a knot. The lame ducks were the *Asama, Yoshino, Nütaka, Fuji,* and *Yashima*. All of these except the *Nütaka* had had boiler troubles, mostly of the "bird-nesting type." Of these all save the *Nütaka* have cylindrical boilers, in most cases nearing the end of their span of existence. The *Nütaka* has water-tube boilers of the Niclausse type, and these appear to have worked well. The ship had either been aground or badly hit, and it was not deemed well to press her upon that account. There is some mystery about her.

Loss of water was experienced in the *Iwate* after an extensive hit during the battle of February 9. Her boilers are of the Belleville type. She would seem to have been hit in the region of the boiler rooms, but her steaming capacity was not effected to any extent, and her own people tightened up the joints that had been sprung.* This ship is at present good for 21 knots. The speed of the *Asama* has sunk to 18 knots or thereabouts; the other cruisers mentioned are somewhere about the same. The two old battleships were down to something like 14 knots, it being considered unsafe to press their antique boilers. The *Mikasa, Asahi, Yakumo, Azuma, Idzumo,* were, at the time of our advices, steaming fast and well; their Belleville boilers had given no trouble at all, and machinery defects had been of a very mild nature. The *Shikishima* had had no boiler troubles, but some small injury had been suffered by the machinery, probably from Russian projectiles.

As was only expected, the destroyers had one and all fallen off in speed under the tremendous strain put upon them. Data of the speed losses are not procurable, nor is it possible to ascertain how far hostile projectiles are responsible. The general feeling on destroyer performances was not one of dissatisfaction, bearing the circumstances in mind. The best steamers of the lot are the *Shiakumo* and *Asashio*.

Only one Russian ship has done much hard steaming, the cruiser *Bayan*. It was the *Bayan* which, when she reached Port Arthur a little before the war, came up at full speed, exceeding her contract rate at the end of a long voyage. She was therefore in the pink of condition, and from all accounts has so remained right through the war, an all-round credit to her designer, her builder, her machinery, her boilers, and her crew.

The *Gromoboi* and *Rossia* are both in good steaming condition, and so is the *Askold*. This ship has Thornycroft boilers; the others have Belleville.

The *Novik* has been several times injured, and, having been also hard pressed once or twice, her machinery has been shaken up a good deal. It is doubtful whether she can do 20 knots at present; possibly not more than 18. Her boilers are said to be in very passable condition.

The *Retvizan* had her engines thrown out of alignment when she was torpedoed, and her steaming powers are very poor, despite repairs. The shock developed leaky tubes, but the repairs were not very lengthy. One tube is said to have burst.

The *Tsarevitch* suffered no hurt at all to machinery or boilers when torpedoed, and her propellers were untouched, though the torpedo hit her rudder. She is still able to steam at a good speed, the steering gear being the only part of her machinery injured.

The *Pallada* was hit amidships by a torpedo that came through the side and exploded partly in a coal bunker and partly right inside one group of her Belleville gen-

*Another version is that the leaks were in the boiler room, not in the tubes at all.

erators. The tubes were torn out and bent S shape. They were taken out, straightened, and replaced, mostly by her own engineers.

A very not dissimilar hit was received by the *Pobieda,* which was hit by a mine in a port boiler room. The boilers run the length of the ship instead of athwartships, and this probably did much to save the men in the room concerned. A great deal of water came in and the fires were quenched, but no one was injured, no tubes burst, and the ship returned to harbor without assistance under her own steam. In harbor the water was pumped out. No repairs were needed save a patch in the side where the hole was. The main engines were quite uninjured.

The three *Poltavas* had well-worn boilers when the war began, and none of them seem to have done more than about 12-knots speed. Lying mostly in harbor, the war has put no strain upon them.

In the early days of the war Russian destroyers were hopelessly outmatched in speed by the Japanese; but the harder service to which the latter have been put has done much to equalize this, and there is little to choose between them now. If anything, the Russians have got better speeds out of their destroyers recently than when the war began, which would seem to indicate that past slackness had much to do with their early failures to steam well with these craft. The fastest Russian destroyer is the Schichau-built *Lieutenant Bourakoff.*

Speaking generally, the engine-room lessons of the war have been as follows:

(1) The impact of heavy projectiles has a strong tendency to affect the alignment of machinery by shock, but less effect than might have been expected upon boilers, whether water tube or cylindrical. Only direct hits seem to have effected the generators.

(2) All small ships, especially torpedo craft, wear out quickly, and lose heavily in speed as the result of hard work.

(3) The deterioration of big ships is considerably less; and in the case of ships like the *Idzumo* and *Bayan,* which were well cared for in days of peace, very little indeed.

(4) Disablement of machinery by gun fire is quite improbable; partial injury is all that is to be feared.

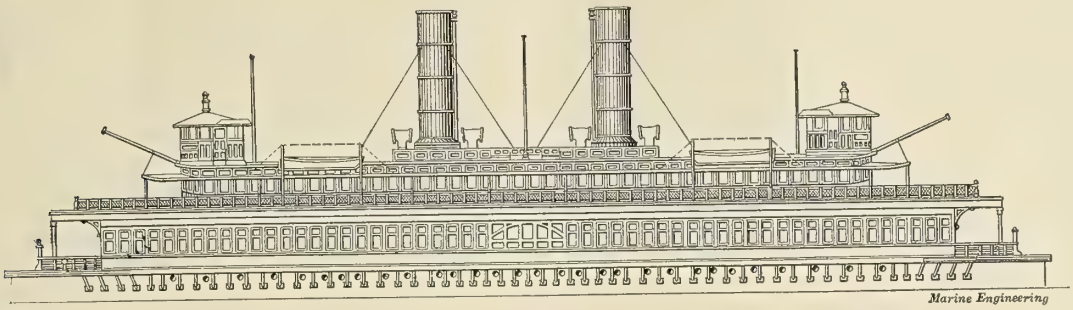
(5) Cylindrical boilers have proved inferior to water tubes; or, at rate, to the Belleville variety, with which most of the water-tube combatants are fitted. The tubes have been easily swept at sea, whereas the cylindrical ships have had to go into harbor continually for cleaning.

(6) It has not been possible to maintain full speed for any length of time in either fleet, though the *Bayan* is said to have steamed nine hours at top speed. One cause of failure has been the physical difficulty of getting the coal to the bunkers quickly enough. It is deduced from this that coal economy is even more important tactically than strategically. A fractional difference in consumption per indicated horse power means a good deal of difference in three hours' coal shovelling, where large horse powers are involved. The *Bayan,* in her nine-hours' run, would certainly have been captured or destroyed had she been unable to keep up the supply of steam. In the majority of the ships engaged, the tendency when full power was wanted was to shovel on coal recklessly. This meant that the boilers were given more coal than they needed, and accelerated physical exhaustion resulted. In the *Bayan,* firing was done by system and regularly, with the result that less coal was burned, more efficiency per pound secured from it, and the physical exhaustion problem of stoking not felt. The ship has always been remarkable for a low consumption, but the firing signalling system employed undoubtedly bore its share in the paradox that "she steamed away from the enemy by burning less coal than they did!" The most pregnant lesson of the war would seem to be that the all-important qualification for a naval boiler is the giving of the maximum result from every pound of coal. The endurance of the stoker is the rock that lies in the way of keeping up continuous full speed.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of August 10, 1904, the following degree of completion of vessels building for the United States Navy:

			Degree of Completion. Per Cent.	
BATTLESHIPS.			July 1.	Aug. 1
Ohio	18 knots.	Union Iron Works	96	97
Virginia	19 "	Newport News Co	62.4	63.7
Nebraska	19 "	Moran Brothers Co	51	54.3
Georgia	19 "	Bath Iron Works	56.42	59.3
New Jersey	19 "	Fore River S. and E. Co	61.6	63.8
Rhode Island	19 "	Fore River S. and E. Co	64.1	66.1
Connecticut	18 "	Navy Yard, New York, N. Y.	44.82	47.3
Louisiana	18 "	Newport News Co	50.79	52.59
Vermont	18 "	Fore River S. and E. Co	10.9	13.4
Kansas	18 "	New York Shipbuilding Co.	13.2	17.7
Minnesota	18 "	Newport News Co	34.27	37.56
Mississippi	17 "	Wm. Cramp and Sons	4.61	6.65
Idaho	17 "	Wm. Cramp and Sons	4.68	6.50
ARMORED CRUISERS.				
Pennsylvania	22 knots.	William Cramp and Sons	82.7	84.2
West Virginia	22 "	Newport News Co.	87.58	89.32
California	22 "	Union Iron Works	61	62
Colorado	22 "	William Cramp and Sons	86.4	89.2
Maryland	22 "	Newport News Co	85.07	86.87
South Dakota	22 "	Union Iron Works	59	59
Tennessee	22 "	William Cramp and Sons	38.5	42.45
Washington	22 "	New York S. B. Co	34.4	38
PROTECTED CRUISERS.				
Chattanooga	16½ kts.	Lewis Nixon	88.94	91.9
Galveston	16½ "	Wm. R. Trigg Co	84	87
St. Louis	22 "	Neafie and Levy Co	43	44.6
Milwaukee	22 "	Union Iron Works	53	54
Charleston	22 "	Newport News Co	76.3	79.5
GUNBOATS.				
Dubuque	12 knots.	Gas Engine and Power Co.	47.7	52.7
Paducah	12 "	Gas Engine and Power Co.	38.7	45.2
TRAINING SHIPS.				
Cumberland	Sails	Navy Yard, Boston	49	57
Intrepid	"	Navy Yard, Mare Island	33.8	43.4
TRAINING BRIG.				
Boxer	Sails	Navy Yard, Portsmouth	55	65
TORPEDO BOATS.				
Stringham	30 knots.	Harlan and Hollingsworth	98	99
Goldsborough	30 "	Wolff and Zwicker	99	99
Blakely	26 "	George Lawley and Son	99	99
Nicholson	26 "	Lewis Nixon	99	99
O'Brien	26 "	Lewis Nixon	98	98



THE NEW FERRYBOATS FOR THE NEW YORK-STATEN ISLAND SERVICE.

The contract recently awarded the Maryland Steel Company, Sparrow's Point, Md., by the Department of Docks and Ferries of the City of New York, is for five steel screw-propelled ferryboats, each driven by two sets of two-cylinder compound engines. The construction of one of these boats has been sublet by the contractors to the Burlee Dry-Dock Company, Staten Island. All boats are to be delivered one year from the date of signing the contract. The specifications and plans were prepared by consulting naval architects Messrs. Millard and Maclean, who, with Mr. A. Ingles, engineer-in-chief of the department, are to supervise the construction. The specifications form one of the most complete sets ever prepared, and cover all points which might possibly arise in dispute.

The boats are to be built in compliance with the labor laws of New York state, which provide for an eight-hour working day, and also in accordance with the rules of the American Bureau of Shipping, by which society they are to be classed.

The general arrangement, which is shown in the accompanying drawings, is for a boat 250 feet long over guards, 66 feet beam over guards, 46 feet molded, 19 feet 6 inches deep. The hulls are of steel throughout, fitted with six water-tight thwartship bulkheads, and in addition to the usual longitudinal members there will be fitted a fore-and-aft latticed girder on each side of the vessel. The upper works are of wood, except the engine and boiler casings, and the fore-and-aft bulkheads dividing the passenger cabins from the wagon ways which are of steel. The hold is devoted entirely to machinery space, and the necessary coal bunkers and water tanks. A collision bulkhead is at each end to take the stern tubes. The remaining space is divided into five compartments. In the center are placed the two 2-cylinder compound engines with crank shafts coupled together. On either side of this is a boiler room in which are placed two Babcock & Wilcox water-tube boilers fitted with blowers for forced draft of the closed stoke-hold system. These boilers are backed against the engine-room bulkheads, and opposite the furnaces are the coal bunkers. The steam-steering engines, and ship's stores are located as shown in the plan. The crews are not to be berthed on board.

On the main deck one cabin is for men and the other for ladies, and in each cross seats are arranged. One innovation is that the upper cabin cannot be reached from the men's cabin, the staircases on this side of boat being at the ends and landing upon the open main deck. This is to avoid the cigar smoke from rising to the upper cabin. Another innovation is the commodious toilets provided. The upper cabin is fitted with cross seats, and thus the seating capacity of all cabins is greatly increased, 861 seats in all being provided. Passengers are to be admitted from the pier to this deck. Pilot houses are on top hurricane deck.

Turning from this brief description we take up in full some of the clauses of the specifications. An estimate is first given of the weights of steel hull, lumber, and machinery as follows:

STEEL.

Plates (steel)	810,000 lbs.
Angles and shapes	396,000 "
Rivet heads	36,000 "
Tubes (stanchions and braces)	18,000 "
Castings and forgings	45,000 "
	1,305,000 lbs.

Total net weight, 1,305,000 pounds—582.5 long tons.

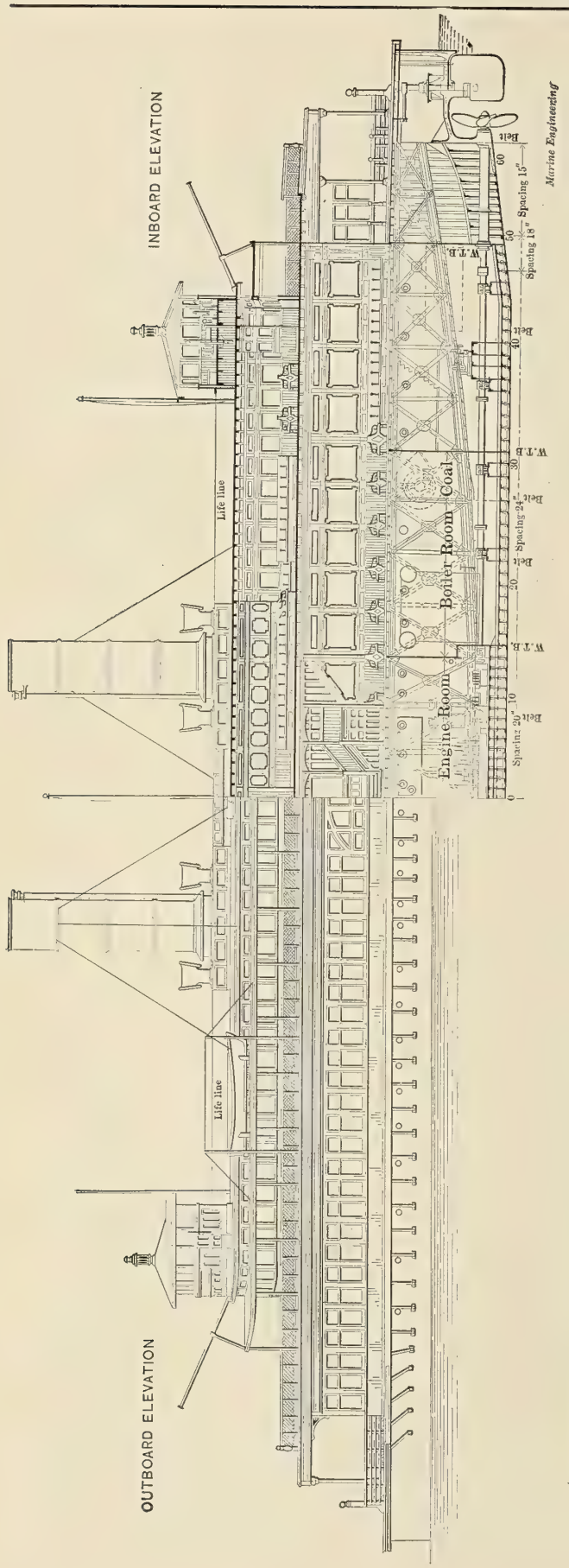
LUMBER.

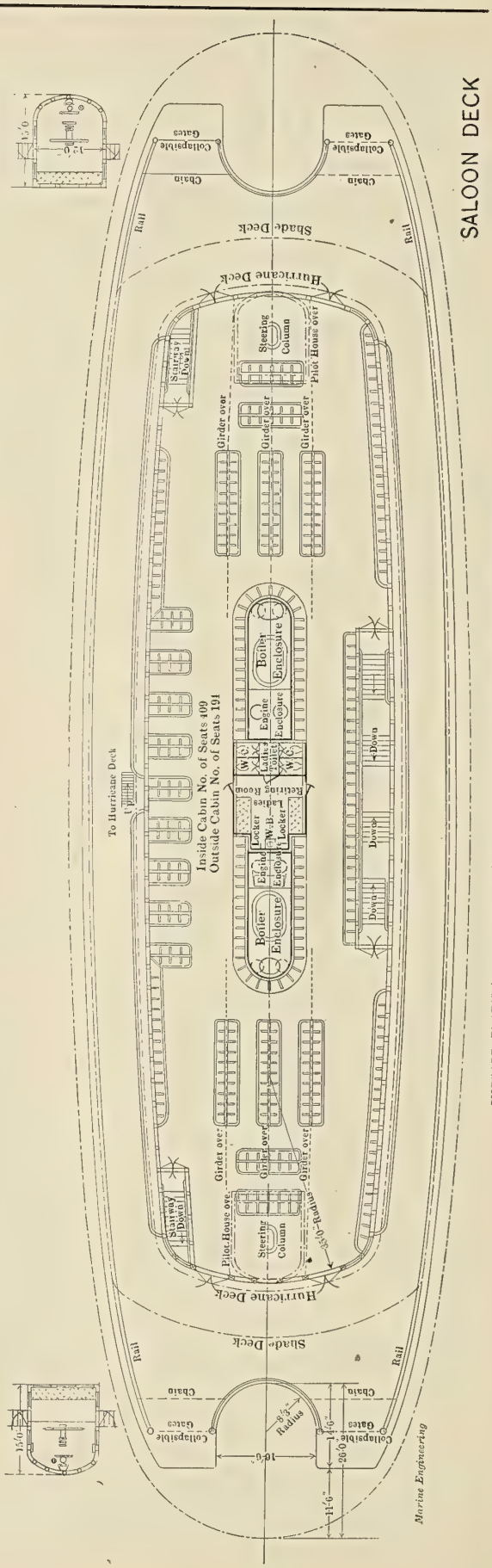
Mahogany,	6,000 feet, board measure	....	25,200 lbs.
Cherry,	11,000 " " "	....	52,200 "
Yellow pine,	27,000 " " "	....	90,000 "
Oregon "	60,000 " " "	....	180,000 "
White "	24,000 " " "	....	60,000 "
Spruce,	15,000 " " "	....	36,000 "
White oak,	7,000 " " "	....	29,000 "
			472,400 lbs.

Total net weight, 472,400 pounds—211 long tons.

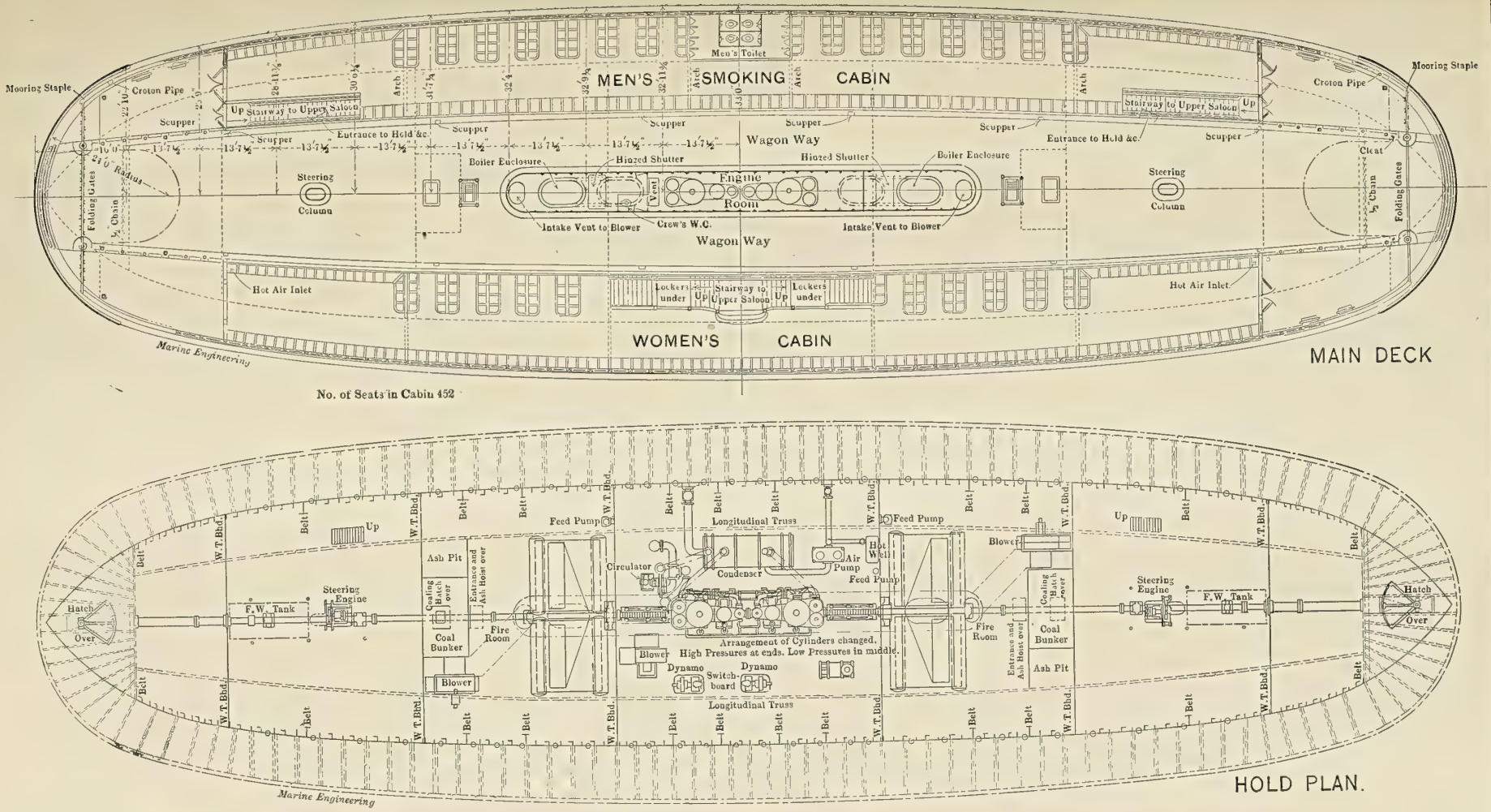
MACHINERY.

Main engines, including crank shafts	180,000 lbs.
Shafting	75,500 "
Thrust bearings	12,000 "
Steady bearings	4,500 "
Propellers	10,000 "
Condenser	22,000 "
Air pump	7,500 "
Main feed pumps	4,000 "
Fire and bilge pump	5,000 "
Sanitary pump	1,000 "
Generating sets	10,000 "
Fire-room blowers	8,000 "
Ventilating blower	4,000 "
Piping, valves, etc.	22,000 "
Boilers, with all mountings full of water	380,000 "
Stacks and uptakes	60,000 "





INBOARD PROFILE AND SALOON-DECK PLAN OF THE NEW STATEN ISLAND FERRYBOATS.



MAIN DECK AND HOLD PLAN OF THE DOUBLE-END, DOUBLE-DECK, STEEL FERRYBOATS FOR THE STATEN ISLAND FERRY SERVICE OF THE CITY OF NEW YORK.

MATERIALS AND WORKMANSHIP.

All materials used in the construction of the boat are to be of the best quality for the purpose, and all workmanship is to be of a thorough character and first-class in every respect. Care is to be taken to insure fair lines, smooth surfaces, and water-tightness. All steel materials are to be subject to the prescribed tests and inspection at the places of manufacture and at the building yards. Plates or shapes which are burnt, or which develop cracks or other defects in working, must be replaced. Plates which show blisters, laminations, or surface defects must be rejected, and plates which are buckeled must be re-rolled. If the buckling cannot be taken out, the plate is to be rejected. All plates and shapes are to be stamped with the manufacturer's name.

Tensile specimens to be uniform in cross section between measuring points, to be 2 inches in length and 1-2 inch diameter for steel castings, and 8 inches in length and a sectional area of not less than 0.5 square inches and not more than 0.8 square inches for plates and shapes. Each tensile test piece to be tested to breaking.

Plates, angles, and shapes for structural hull work are to be of mild steel, having an ultimate tensile strength of from 58,000 to 65,000 pounds per square inch, an elastic limit of one-half the tensile, a reduction in area at point of fracture of at least 35 per cent., and an elongation of at least 20 per cent. in a length of 8 inches. Pieces from any plate selected by the inspector to be cut to a width of four times their thickness, and must stand bending to an angle of 180 degrees, around a pin of a diameter equal to the thickness of the sample, without fracture on the convex side, either cold or after being heated to a cherry red and quenched in water. Angles and shapes must be free from cracks, holes, or splits, and must stand flattening out cold, and then doubling up till the edges meet, without fracture or crack.

All rivets to be of the best quality soft, tough steel, long rivets to be capable of being doubled back on themselves cold without cracking, and short rivets flattened into their heads cold.

Forgings, the working of which has required more than one heat, or in which the metal was only partially heated, should be annealed, and all forgings must be capable of passing the same tests as for structural hull steel mentioned above.

Blacksmith work is to be smooth, strong, and neat, and galvanized by the dipping process where specified.

All steel castings are to be true to pattern and free from shrinkage cracks, blow holes, warping, foreign substances, or other defects. Cast steel is not to have more than .06 of 1 per cent. of phosphorus in its composition.

All steel castings are to have an ultimate tensile strength of from 60,000 pounds per square inch to 70,000 pounds per square inch, with a minimum elongation of 18 per cent. in 2 inches, and a minimum reduction of area of 25 per cent. The minimum elastic limit to be one-half the tensile strength.

A bar 1 inch square shall stand bending cold, without showing cracks or flaws, through an angle of 120 degrees, for castings for moving parts of machinery, and 90 degrees for other castings, over an inner diameter of 1 1-2 inches. Steel castings are to be annealed, unless otherwise ordered.

Iron castings must be free from blow holes, shrinkage, or other cracks, porous places, or other defects, and shall be of standard quality.

All iron and steel castings before being painted are to be cleaned and all roughness removed. Such castings as for engine columns and bed plates are to be cemented before painting as required.

Steel forgings for the machinery to be of the best quality, mild, open-hearth steel, and free from blisters and holes. To have an ultimate tensile strength of not less than 60,000 pounds per square inch, with an elongation of not less than 28 per cent. in 2 inches. Longitudinal bars 1-2 inch square, cut from each forging, must stand bending cold through 180 degrees to an inner diameter of 1 1-2 inches without showing cracks or flaws.

All flanges and collars, especially to machinery, are to have well-rounded fillets. All moving parts of machinery are to have lock nuts or split pins, or both. Collars, etc., keyed on shafts of moving parts are to be also pinned. Wherever possible, keys should be nibbed to facilitate removal.

The ends of studs and bolts in sight are to be cut off and finished. Bolt heads and nuts for machinery, where in sight, are to be hexagonal and neatly finished.

All composition castings are to be made of new materials, and the proportions of ingredients for the various alloys to be as approved.

Anti-friction metal to be equal to Parsons white metal.

All iron fastenings for wood work throughout, nails, bolts, rods, etc., to be galvanized unless otherwise specified. Brass to be used for exposed fastenings in joinery.

All steel work to be thoroughly cleaned before being painted, and it is recommended that in order to remove mill scale the steel is allowed to rust and the rust cleaned off with wire brushes before applying paint.

All lumber is to be clear, well-seasoned, and free from sap, shakes, and large or loose knots or other defects. White pine used for panels, moldings, etc., to be thoroughly seasoned and kiln dried. Mahogany, cherry, and other hard wood to be clear grained, thoroughly seasoned and free from knots, knurls, worm holes, and other defects.

(To be continued.)

MARINE ENGINEERING DATA CARD. SEPTEMBER, 1904.

NAMES—

LAUNCHED—

NATIONALITY—American. TYPE—Steel screw propelled ferryboats.

BUILDER—Maryland Steel Co. OWNER—City of New York.

Length over guards.....250 ft. 0 ins.
" to outside of sternposts.....247 " 0 "
" " propeller posts..218 " 0 "
Breadth, molded.....46 " 0 "
" over guards.....66 " 0 "
Depth, molded.....19 " 6 "
Draft to bottom of keel.....12 " 0 "
Freeboard.....7 " 6 "
Engines: Number of.....two
Type.....2 cylinder compound
Cylinder diameters, each set..22 1-2 and 50 ins.
Stroke.....30 ins.
Valves.....piston
Piston rods, diameter.....5 1-2 ins.
Crosshead pins, two, 6 1-2 by 6 1-2 ins.

Connecting rods, diameters, 5 1-2 ins. top; 6 1-4 ins. bottom
Connectig rods between centers.....75 ins.
Shafting, diameter crank and line.....12 "
" " thrust and propeller, 12 1-2 "
Condenser.....one for 2 engines
Cooling surface.....4,500 sq. ft.
Boilers: Number.....four Babcock & Wilcox
Working pressure.....225 lbs.
G. S., total.....340 sq. ft.
H. S. " .....12,500 " "
Propellers: .....four blades
Diameter .....11 ft.

SUBSIDIES WITH RELATION TO AMERICAN SHIPPING.

The necessity of increased means of international transportation under the American flag is now a well-recognized fact in this country; and, whatever differences of opinion may exist as to the best means to be employed to realize such a desideratum, none but the most utterly prejudiced will venture to deny the immense advantages which would be derived by the possession of an efficient fleet of steamers and sailing vessels capable of undertaking, under the American flag, the work now being performed by foreign vessels for the special benefit of foreign owners, and to the detriment of our own people. Without entering unnecessarily into the national or political aspect of the case, it may be of some interest to review, for our own benefit, what some other countries have done to increase their mercantile marine and the effect such legislation has had upon their competitors in this race for the carrying of the world's produce, a large percentage of which is taken away from our shores.

England's preponderance as a maritime power has enabled her to retain the lead, and her ships are still found in every part of the globe. This situation, which at one time threatened to become unique, was the means of inducing other countries to adopt some method whereby this monopoly might be checked and at least a portion of the world's commerce wrestled from her grasp. Hence the subsidies and bounties which, in some form or other, were voted by their respective governments in favor of German, French, and Italian vessels, to stimulate their increase in number and as a compensation for the additional cost of building or handling said vessels under conditions less favorable than prevailed in Great Britain, where, for generations, shipbuilding and ship owning have been paramount.

Germany took the matter up, and, with that steadiness of purpose which characterizes the Teuton, has raised herself, within a comparatively short period of time, to a position which seriously threatens her rival, so far at least as specimens of naval architecture and feats of engineering are concerned, for no finer vessels than those plying between New York and Hamburg, etc., under the German flag need be wished for. It is fair to assume that nothing short of the material aid (officially acknowledged or not) afforded by the government for the building and operating of these maginificent vessels could have enabled even those powerful companies to achieve such success.

France was almost the first to make a determined, if not altogether successful, attack on the British position, by enacting a law having for its object the increase of the mercantile marine, and according to which, after the first of January, 1893, no foreign-built vessel would, as heretofore, participate in the partial bounty then allowed after her transfer to the French flag.

The law of 1893 provided for a bounty to the builder as compensation for custom and other duties on material, etc., this being equivalent to $13.00 per ton gross on every sea-going ship, plus $30.00 per ton weight of machinery placed on board said ship.

The owners were entitled, for a period of ten years, beginning at any time from 1893 to the 31st of December, 1903, to a substantial subsidy (averaging, in the case of sailing vessels, about twenty-two cents per ton gross for each one thousand miles run), taking effect on the date of the official registration of their vessels; and, there being practically no limit to the number of vessels which might be built to benefit by that law, it is needless to state that quite a large number of these vessels were hurried up and placed in commission. The chief trouble appears to have been that there was not enough foreign trade from home ports to meet the demand, and that the Frenchman's general lack of enterprise, principally in industrial and commercial pursuits, prevented him from making the most of what has since been acknowledged as a most extravagant piece of legislation, somewhat detrimental, after all, to the best interests it was intended to protect.

As an explanation of the last paragraph, it may be stated that as the French shipping bill of 1893 accorded the highest navigation subsidy to sailing vessels, only very few steamers were built under it, and the country at one time had over a hundred steel sailing vessels under construction, whilst only one such was building in the whole of Great Britain. These facts, as well as the tremendous rush made upon the national treasury, helped to intensify the feeling that the law was acting in the wrong direction; and, since then, a new law has been enacted to benefit steamers in preference to sailing vessels; a limit has been placed upon the annual appropriation allowed by the government as bounty, and the whole considerably modified, although still of a strictly protective nature.

Having outlined the general principles on which an attempt has been made in France (somewhat similar legislation has been passed in Italy) to increase the importance of its mercantile marine and afford protection for same, let us now proceed to examine, as far as practicable, the effect this foreign legislation had upon shipping in general. Although we may not be concerned particularly with its immediate effect upon the country itself, it is interesting to note that the impetus given to this important question of shipping in France benefitted hundreds of thousands either directly or otherwise, and helped materially to arrest the decay of a national industry which up to that time was gradually disappearing.

To fully appreciate these exceptional conditions, it must be remembered that the main object of the French ship owner, under the provisions of the law, is to navigate his vessel with or without cargo, the subsidy being paid on the tonnage and distances run, irrespective of the fact that said vessel may be carrying a valuable cargo of merely the amount of ballast required to keep her in proper trim. This is extremely important from the owners' point of view, and, as it does not take a very clever mathematician to work out the profits which might, under certain circumstances, be derived by such an enterprise, it will also be quite easy to realize the effects upon the maritime world of a fleet of vessels bent upon obtaining freight at any cost in order to "keep going." Merchandise from one port to another with an assured cargo for return to another port, need no longer be of primary importance, and hence we have seen scores of foreign vessels leaving their home ports in ballast for the Pacific or the Atlantic coasts, to return from our shores with a full cargo at a price considerably below

(as low as 70 per cent. and less) than that which other vessels less favored were able to obtain, even to cover working expenses and risks.

Nor is this all: The tonnage of these vessels is not regulated by the same by-laws as ours, nor are they hampered by the regulations of a board of trade as to their freeboard. While as in this country government officials are supposed to attend to these matters, these officials are not invested with the necessary powers to deal properly with that intricate problem, and the only check placed upon most of the foreign ships carrying freight to or from the United States is to be found in the opinion occasionally expressed by stevedores or surveyors of cargo whose decisions vary chiefly in accordance with the custom of the port in which they reside. We know from practical experience that these opinions are arbitrary and that this item of freeboard alone supplies another element for keener competition against vessels which are made to conform to certain rules and regulations as to their maximum load line.

While this important question should perhaps form the subject of an entirely separate article, it may not be out of place to state here that no equitable basis for fair competition in the carrying of freight by sea will ever exist before a universal method of assigning a *maximum load line* has been adopted. Other instances could be quoted and comparisons made to further illustrate the kind of competition this country has to contend with when dealing with subsidized ships of other nations; but, so much has already been said and written on the subject of the difference in wages, cost of food, cost of operating ship, etc., that it would seem tedious to repeat what is so well known to most of those connected with the trade. Facts, however, may be reviewed as follows:

Subsidies granted by some foreign governments in favor of certain classes of ships engaged in the ocean freight-carrying trade have created a state of things prejudicial to the interests of this country at large, and something should be done to meet the emergency, not only in counteracting the effect of these subsidies upon our own means of exportation, but also with a view to increasing the importance of our mercantile marine, which, as far as the foreign trade is concerned, threatens to disappear entirely. Whether this should be done by subsidies granted to builders and owners as compensation for the difference in the cost of building and operating ships under the American flag, or, whether a similar result might be obtained by other means, is a question which the Merchant Marine Commission, recently appointed by congress, will no doubt endeavor to answer.

In the meantime, it may be stated broadly that, except for the immediate and direct benefit derived from an increase in the shipbuilding and engineering trades, the French subsidies have practically proved a failure so far as the national aspect of the case is concerned. The demands made upon the treasury compelled the government to place a limit upon its annual expenditure on this account, and the number of subsidized vessels turned out have mainly contributed in reducing freight to such an extent as to paralize the shipping trade, making it an impossibility for any ship owner not so favored, to compete in the open market. Yet is should not be forgotten that this result is chiefly due to it being a one-sided combination and that had this country enacted a law whereby the American shipping could have been protected against this attack, matters would be quite different now.

It follows that something should be done. We are given to understand that owing principally to the cost of labor in this country, vessels cannot be built to compare favorably with prices charged on the other side (say in Great Britain); also, that owing to the present rate of wages and other incidental expenses, said vessels cannot be operated on the same terms. This would seem at once to call for compensation in the shape of governmental aid of some sort, as the only means whereby builders and owners alike can successfully meet their foreign competitors, and there is plenty of evidence to show that this view is shared by many. Yet others are of opinion that the intervention of the government in such matters is liable to restrict the freedom of individuals; and some, in defending these premises, will not fail to call attention to the fact that certain well-known shipping firms on the other side owe their expansion and success to the unlimited freedom they have enjoyed as private concerns, unhampered by the many formalities governmental assistance of any kind generally entails.

It is just possible that both these opinions are erroneous, like all propositions representing extremes, and that in questions wherein the commercial welfare of a nation is concerned, it is primarily the duty of a government to foster legitimate trading by suitable legislation, provided always such legislation be judiciously applied. Private enterprise should always be encouraged, and when such enterprise becomes of national importance, susceptible of affecting several millions of subjects whose interests are more or less directly involved, it is unquestionably the duty of the state to come forward with a measure so framed as to afford it protection. This may be done in various ways, and, as a means of counteracting the effects of those foreign subsidies upon our own mercantile marine, provisions might be made not only to reduce the tonnage and freeboard of subsidized vessels to a universal standard, but, if necessary, to impose upon them, according to tonnage measurement, a duty or tax which would help equalize the cost of transportation.

With regard to the best means of increasing our mercantile marine in order that this country may hope to obtain her legitimate share of the business it creates through her immense resources, there seems to be no doubt that either the American ship builder should be assisted to enable him to compete against his foreign rivals, or that American-built vessels should benefit by certain government grants as a compensation for their extra cost, both when being built and operated. But, bearing in mind the course adopted by other nations and the ultimate results obtained by them, any congressional legislation should be framed with the following points carefully considered:

(1) No subsidy should be granted in cases where a vessel is navigating in *ballast,* and said subsidy should be based on the displacement or carrying capacity at the time of leaving port rather than on the tonnage (net or otherwise), in order that it may be granted only in proportion to the effective work performed.

(2) Should any limit be placed upon the annual amount of appropriation to be voted, care should be

taken that the whole of this sum be not absorbed in anticipation by a syndicate or trust, as is now the case in France, where some ship owners are unable to close upon a contract without having to wait for several years before their vessels can benefit by the provisions of the law, each one being taken in rotation.

(3) A suitable freeboard should be assigned to every ocean freight-carrying craft so that the maximum load line thus obtained should not be exceeded.

(4) Speed, in steamers, should also be taken into consideration in granting premiums, so that, in case of need, vessels of a certain class, fulfilling the requirements of the admiralty or government inspectors, might be utilized as transports.

The suggestion that subsidies, if any, should be based upon displacement or carrying capacity and not on tonnage measurement, is made not only on account of its simplicity of application to all types of new ships, but also because it seems much more equitable than the system adopted by the French shipping bill of 1893 by which subsidies were paid on the *gross tonnage*. This led to the construction of abnormal types of sailing ships in which, owing principally to the extent of the superstructures, a difference of some 400 tons or more between the net and the gross tonnage of a 2,000-ton ship was a common occurrence.

Many of these vessels are still in existence and seeing that peages and dock dues are paid on the register tonnage, while the bounty was paid on the gross tonnage, one can easily imagine how some of those vessels were crowded with costly superstructures, absolutely useless to their navigation but intended only as an additional means of revenue. The principle apparently adopted by the French authorities was that whereas every cubic foot of enclosed space could be claimed under the bill, only such spaces as could nominally be used for freight were liable to pay dock dues, and represented what is termed the net tonnage.

This led to a lot of abuse and is one of the reasons which, besides involving much additional expense both in the cost of building and in government grants, finally created a considerable amount of opposition to a protective measure, which as a fundamental principle of political ecenomy, was not without some good points under the special circumstances in which that country was placed. Something, however, had to be done in self defence, and it is submitted that a similar proposition is now before us if the United States does not wish to abandon its natural rights to a preponderence in the ocean transportation of the world's greatest producing country.

H. W.

Shallow-Draft Gunboat Widgeon.

Below is given an illustration of the twin-screw, shallow-draft gunboat *Widgeon*, built by Messrs. Yarrow & Company, Limited, Poplar, London, for the British government. A description of this boat was given in Marine Engineering of July, 1904, on page 315. The points of special interest in construction are, first, that the hull is built in floatable sections arranged in such a manner that they can be readily united while afloat, thus avoiding the necessity of riveting together and launching in a foreign port to which the vessel is shipped and where skilled labor may not be obtainable; secondly, that Yarrow patent-hinged flaps are fitted at ends of tunnels in which the propellers rotate, thus securing increased speed and maximum efficiency at all conditions of load. The *Widgeon* is 116 feet long, 24 feet 6 inches beam, draws 2 feet 5 inches with 40 tons on board, and on a two hours' trial averaged 15 statute miles.

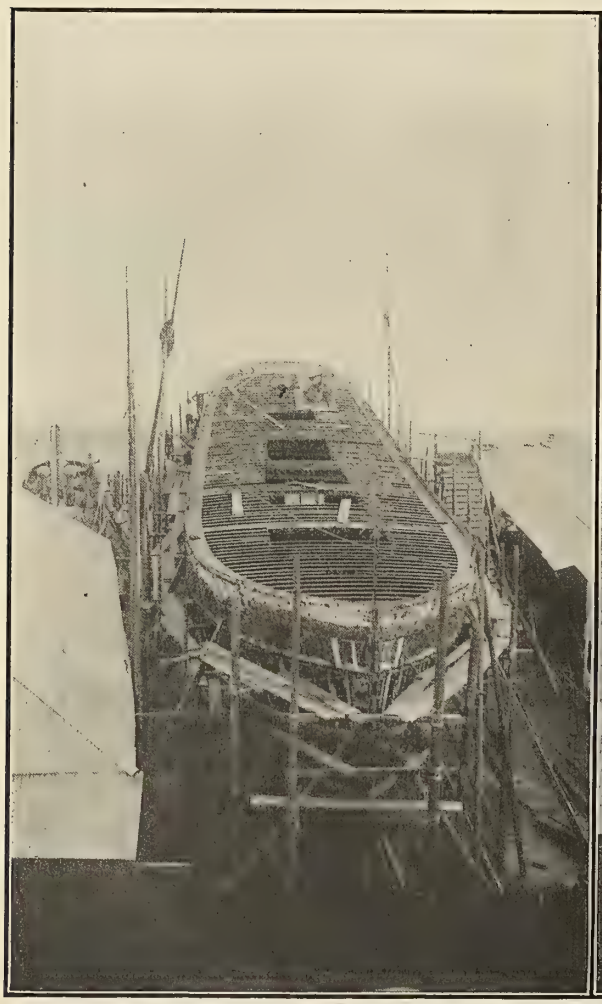
SECTIONAL SHALLOW-DRAFT GUNBOAT FOR THE BRITISH GOVERNMENT.

Capt. Alfred T. Mahan.—As a recognition of the great work done by Capt. Mahan at the U. S. Naval War College, Newport, R. I., and his prominence as a naval authority, an association has been formed by Mr. A. M. Davis, 1947 Broadway, N. Y., to present to the Naval War College a portrait of Capt. Mahan.

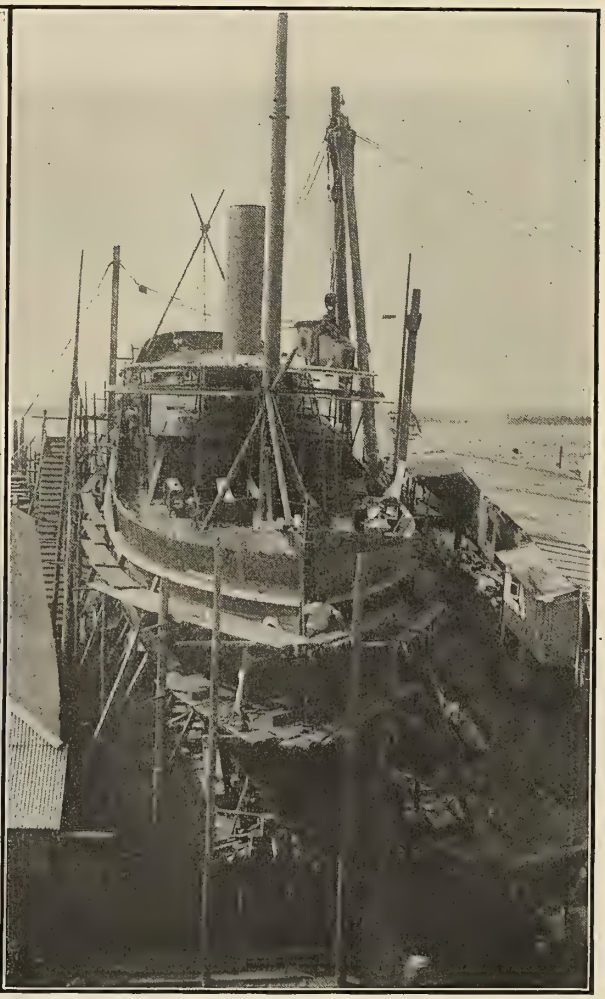
Italian Sea-going Salvage Tug Sars.

There was recently launched at Sampierdarena, Genoa, the ocean-going salvage tug *Sars,* built by the Società Cooperativa di Torduzione. This company started in a very small way seventeen years ago, but has grown rapidly from a small blacksmith shop to a shipyard sufficiently large to launch ocean-going vessels. The engine shops are in a different part of the town.

The launching of the *Sars,* herewith illustrated, took place after the vessel was completed with all machinery and equipment on board. The principal dimensions will be found in the data card on the opposite page.



The hull on August 15, 1903.



Shipping the cylinders, September 15, 1903.

BUILDING A SEA-GOING TUG AT SAMPIERDARENA, ITALY.

The hull is strongly built of mild steel with iron deck and pilot house. There are seven water-tight bulkheads extending to the main deck, the forward collision bulkhead forming the fore-peak tank. Coal bunkers are placed alongside the boilers. The numerous water-tight sub-divisions not only make the boat a very stanch and safe craft, but permit trimming both longitudinally and transversely if it ever should be necessary in the salvage work for which she is intended. The vessel is rigged in the usual manner with two pole masts and two stacks. The equipment consists of two small boats hung on hinged swinging davits, anchors and chains, and a heavy derrick boom is fitted to each mast. There is one large hatch forward and another aft and at each is placed a steam winch. The other deck equipment consists of a steam windlass and compound hand and steam steering gear.

The propelling engine consists of a three-cylinder, triple-expansion engine turning left handed; the cylinders are supported by four forged steel columns at the front and three cast-iron columns and condenser casing at the rear. The high and intermediate cylinders are fitted with single-ported piston valves, while the low pressure has a double-ported slide valve. The valve gear is of the Stephenson link type with double-bar links. The cut-off may be adjusted from .55 to .70 in the high-pressure cylinder valve by means of the usual screw and sliding block, while the cut-off in the intermediate is set at .66, and that in the low pressure at .70. The pistons are of cast iron, disk shape, and are fitted with two backing links. The rods are forged in one piece with the crosshead, and, like the connecting rods, eccentric rods, and valve stems, are of forged steel with high tensile strength. The crosshead is made with

slippers of bronze faced with white metal. Cast-iron lips are bolted to each side of the ahead guides to take the thrust when backing. The eccentrics are of cast iron and the straps of phosphor bronze.

worm with a hand rachet. The crank, thrust, line, and propeller shafting is solid forged steel. The crank shaft is in one piece with cranks set at angles of 120 degrees. The sequence of cranks, also the sequence of

ITALIAN TUG BOAT SARS, ABOUT TO BE LAUNCHED WITH ALL MACHINERY ON BOARD.

MARINE ENGINEERING DATA CARD. **SEPTEMBER, 1904.**

NAME—Sars. NATIONALITY—Italian. TYPE—Seagoing tug.

LAUNCHED—1903. BUILDER—S. Cooperativa di Torduzione. OWNER—

Length over all	147 ft. 0 ins.
" between perps	140 " 0 "
Beam	26 " 6 "
Depth	14 " 3 "
Draft, load	10 " 8 "
Wetted surface	5,016 sq. ft.
Displacement	600 tons
Speed, on trial	13.1 knots
Engines: Number	one
Type	3-cylinder triple
Cylinder diameters	19, 29 5-8 and 50 ins.
Stroke	29 5-8 "
Valves	Piston on H. P. and I. P.
Piston rods, diam	3 3-4 ins.
Connec. " " mean	4 ins.
" " L between centers	59 "
Shafting, crank and line diam	8 3-4 "
" propeller	9 1-2 "
Condenser, cooling surface	1,528 sq. ft.
Propeller: Material	cast iron
Blades	four
Diameter	10 ft. 2 ins.
Pitch	14 " 0 "
Hub. diameter	28 3-4 "
Area, projected	22.5 sq. ft.
Boilers: Number	two
Type.	Scotch
Steam pressure	150 lbs.
Diameter, mean	11 ft. 10 ins.
Length, "	10 " 1 in.
Furnaces, least inside	43 1-4 ins.
Tubes, each	166 plain: 68 stay
Size	3 ins. by 7 ft. 5 1-2 ins. long
G. S., two boilers	94.6 sq. ft.
H. S., " "	3,122 " "

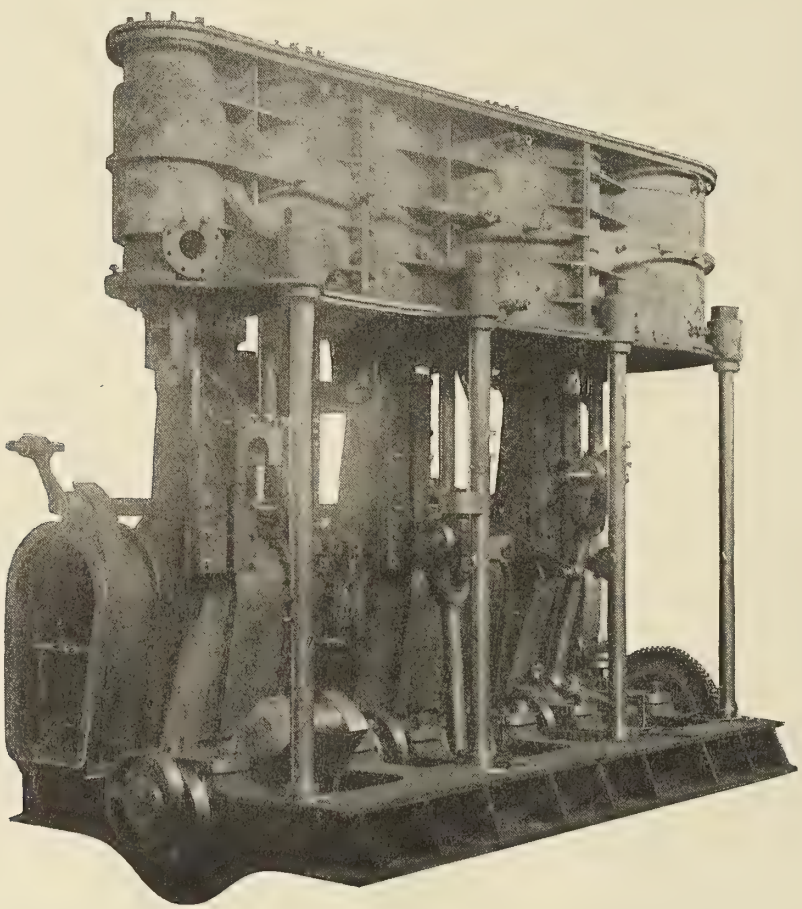
The engine bed plate is of cast iron, in one piece, and bolted to the condenser by flanges at the ends of the six girders of the bed plate. The steam reversing gear consists of a worm wheel on the main shaft worked by a

cylinders, is high-, intermediate-, and low-pressures. The propeller shaft is covered with two bronze sleeves, the stern tube is lined with lignum vitæ staves. The thrust bearings, of the horse-shoe type, are secured

firmly to the hull and the bearing faces are of white metal.

The cast-iron shell of condenser is 13 feet 8 inches long and contains 556 3-4-inch o. d. tubes. The water makes two passes through the tubes. The circulating pump has a 35 1-2-inch runner and a pair of discharge orifices 10 5-8 inches diameter; it is driven by a compound vertical steam engine of 10 horse power, with cylinders 4 3-4, 8 1-4 by 5 inches stroke. This pump is arranged to draw from the sea or bilge, and at 150 revolutions delivers 450 tons of water per hour. The direct-connected air pump is 15 inches diameter and 14 3-4 inches stroke, and is worked by levers from the low-pressure crosshead.

The propeller is of cast iron of the modified Griffiths type with four variable pitch blades of dimensions given in the data card. Steam is supplied at 150 pounds pressure by two boilers placed with axes fore and aft. Each is fitted with two Morison furnaces. Further particulars will be found in the data card. A complete set of feed pumps is fitted, as well as bilge, fire, sanitary pumps, and electric-lighting plant. There is also a large centrifugal salvage pump placed on the starboard side of engine room and driven by a compound 200 H. P. steam engine capable of handling 3,500 tons of water per hour. The inlet and discharge orifices are 27 inches diameter.



TRIPLE-EXPANSION ENGINE FOR TUG-BOAT SARS.

THE ECONOMICS OF POWER ENGINES.

BY BERNHARD A SINN.

The various means for generating power for marine purposes may be classified into two distinct types: either by means of latent heat stored in a gas or vapor, which, when expanded, will give up this heat, or by burning a gas in a closed retort, the expansion of which, due to the heat of combustion, will do useful work by the emission of heat energy. In either case the result obtained is the same, but the means employed vary considerably, and cause the adoption of different types of mechanism. In the former class may be mentioned steam and hot-air engines, thermal engines, alcohol and ammonia machines. In the latter class are the various types of explosive engines—gas, gasoline, and kerosene. It is principally with this latter class of engines that we have to deal with at present.

In the explosive engines heat is supplied in the form of a gas, which, when properly supplied with air, forms a mixture, which, when ignited, burns, and the energy thus supplied is converted into useful work. As with all heat motors, the efficiency of the same is intrinsically low owing to the unfortunate fact that a great part of the heat is wasted, due to the present-day means employed in its utilization; the amount lost as compared with the perfect engine varying with the type of engine.

STEAM-ENGINE EFFICIENCY.

In the engines employing latent energy, such as vapor or steam engines, the heat is converted directly by its giving up heat energy and doing useful work.

In the steam engine, the graphic illustration below shows the distribution of the total energy in the coal, and by comparison with a similar diagram for explosive engines, readily shows the large wastes of the former as compared to the latter.

The energy in the coal, assuming a good coal containing 14,500 B. T. U., reduced to foot pounds energy would be 11,281,000 foot pounds per hour. Of this energy there is given to the steam all but what is lost in radiation, incomplete combustion, and stack exhaust of the boiler. Part of this in the most modern plants is saved by means of superheaters and air reheaters, although some mechanical energy is used to obtain this result. However, figuring on the best practice, where an evaporation of 12 pounds of steam per pound of coal has been obtained at 225 pounds pressure from feed water heated by the exhaust gases to about 200 degrees Fahrenheit, the amount of energy given to the steam would be 9,345,336 foot pounds, at an efficiency of 83 per cent. for the boiler. This result is about as good as has yet been obtained in actual practice.

The various wastes of boilers of good marine or water-tube type may be shown as being distributed as follows:

Energy given to steam.....	83	per cent.
Radiation and other heat losses..	9.5	" "
Incomplete combustion	.7	" "
Wastes in flue, including heating vapor in air, moisture in coal, etc.	6.8	" "

It will thus be seen that in the very best practice, where every possible means known to modern sciences is employed for the reduction of heat and other losses with refinements that only pay where the largest power is employed, the total maximum energy that could be given to an engine would be 83 per cent. of the total heat energy in the coal, provided there were no losses in the conversion of heat energy to work, in the engine. But before we can utilize this steam in an engine we must carry it from the boiler to the engine. This process is always attended with some loss, depending, of course, upon the length if piping between the engine and boiler, and the methods employed to conserve the heat. In the very best practice there is bound to be a loss from 1 to 4 per cent., and it is thus impossible to derive the full efficiency of the heat energy in the steam even were there no losses in the engine itself.

The modern steam engine, although far in advance of its predecessors of fifty years ago, is still the most wasteful form of heat engine known to engineers. Steam of 250 pounds pressure has a temperature of 400 degrees Fahrenheit, which would be 861 degrees above the absolute zero. If we were to expand to 1 pound pressure absolute and condense the steam into water at that point, we would still be throwing away 101 degrees Fahhenheit, or 562 degrees absolute. This clearly shows that with high-pressure steam, and were there absolutely no losses in the conversion of the heat, we would be able to use only 34 per cent. of the total heat in the steam. In practice, of course, an expansion to 1 pound absolute for mechanical reasons is impracticable, and 26 inches of vacuum, or about 2 1-2 pounds back pressure, is as good as can be obtained. This will only give us 32 per cent. efficiency, provided there were absolutely no thermo-dynamic losses. The efficiency of a steam engine depends, of course, on a variety of things—mechanical, physical, and chemical. One of the principal losses of heat and energy is due to condensation and radiation. This latter in high-pressure engines has been considerably reduced by means of steam jackets, but still a loss of from 3 to 12 per cent. of the useful work, depending upon the style of engine, results in this way. The loss in mechanical efficiency is, of course, due to the construction of the engine, to the friction of the various moving parts, and the friction of the load, which vary from 3 to 25 per cent., depending upon the construction and condition of the engine. In the most modern engines of the marine type of large power, 90 per cent. mechanical efficiency would be considered a very fine result. The next loss in the engine is due to leakages of steam, clearances of the cylinders, and unequal and imperfect expansions. These causes, all taken together, make a total loss in efficiency from the theoretical of from 40 to 60 per cent. In good modern design, 50 per cent. is very good practice. Thus it can be seen that the total amount of energy given to the engine in the very best practice is 83 per cent. less 2 per cent. loss in transmission, 68 per cent. loss in thermal efficiency, reducing the amount of energy available to 26 per cent.: 45 per cent. cylinder and other waste-heat losses and 10 per cent. loss in mechanical efficiency, reduces in the

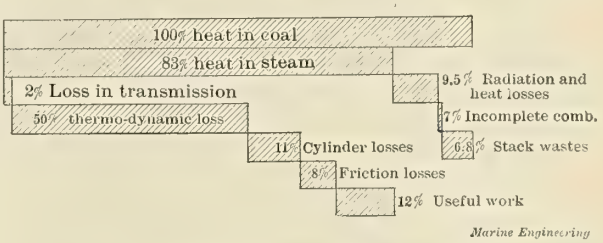


FIG. 1.—STEAM ENGINE AND BOILER.

very best practice in large plants, the total available energy which may possibly be put into useful work as 12.8 per cent. Of course, in the average engine, where steam of not over 100 pounds is used, non-condensing, the total efficiency would hardly exceed 8 per cent. Where we are able to use 12.8 per cent. of the actual total energy in the coal in useful work we would be able to develop a horse power on 1 1-3 pounds of coal per hour. This result, under actual running conditions, has hardly ever been obtained on land, and very rarely in the largest boats at sea. The diagram in Fig. 1 gives a graphic illustration of the heat losses in the various processes through which the coal or energy in the coal is transformed to useful work in the steam engine.

EXPLOSION ENGINES.

Let us now investigate the question of the heat engine of the explosive type. We may operate under various conditions but in almost all cases, oil of some kind or other or a fixed gas is sprayed or pumped into the cylinder of the engine, where, with the proper supply

of air the mixture is burned and the energy in the gas, whether it is a stable or light gas, is immediately expended on the piston.

The accompanying diagram, Fig. 2, shows the distribution of heat losses in a gas engine. The possible thermo-dynamic efficiency in a gas engine is much higher than that of a steam engine. The heat of explosion is about 1,900 degrees absolute, and in modern engines of good type and of good design the exhaust gases have been brought down to a temperature of 700 degrees, which would give us an efficiency of approximately 40 per cent., while in actual practice, 35 per cent. is the maximum that has yet been obtained owing to other wastes. Of the total energy given to the engine there is lost in radiation and exhaust 40 per cent.; this can hardly be reclaimed except by utilizing the heat of the exhaust to perform useful work in other directions.

In order to prevent undue mechanical strain owing to the physical properties of the material employed in construction, it is necessary to use artificial means to cool

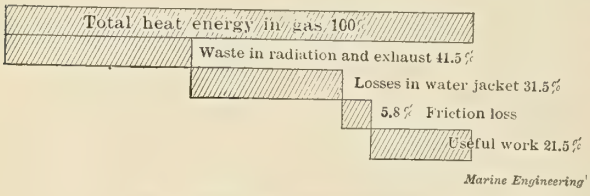

Total heat energy in gas 100%
Waste in radiation and exhaust 41.5%
Losses in water jacket 31.5%
5.8% Friction loss
Useful work 21.5%
Marine Engineering

FIG. 2.—GAS OR GASOLINE ENGINE.

the cylinder of the engine. The heat loss in the cooling jackets amounts to 33 per cent. of the total heat supplied to the engine. This still leaves us 27 per cent. of the total energy supplied to the engine to be applied to useful work. This may be compared with the indicated power of the steam engine, and from the diagram before shown we actually, instead of utilizing 12 per cent. of the total energy in the coal in useful work, we are able in the gas engine to use 27 per cent. of the gas or gaseous fuel. Unfortunately the mechanical efficiency of the gas engine has not yet obtained the efficiency of the steam engine, and we are thus able to actually only use 20 per cent. of the total energy of the gas, in useful work. But even this offers far greater possibilities than the steam engine, particularly in view of the fact that we have no accurate data of the efficiency of large gas engines, say of 5,000 or 10,000 I. H. P., and such comparisons as we make must be made with small engines of the explosive type as compared to large engines of the expansion type. If anything like the same increase of efficiency between large and small gas engines is obtained as is noticed between large and small steam engines, there should be a marked saving in the result from present gas engines, when the commercial feature of operating and obtaining fuel reaches a more satisfactory point.

We thus see from the engineer's point of view that the use of a gas engine, from the standpoint of economy, is much greater than that of the steam engine, but the commercial side of the question enters largely into the acceptability of one or the other type. If we were able to obtain oil fuel for use in explosive engines at the same cost per thermal unit as coal there would be no hesitation whatsoever on the part of engineers in utilizing the explosive engine in larger powers, provided the question of safety did not enter in. Fuel oil per pound contains approximately 18,000 thermal units. Coal per pound contains 14,000 thermal units. The price of coal per hundredweight is approximately 14 cents, taking coal of good quality placed on board the ship. Fuel oil per hundredweight costs approximately 37 1-2 cents. In the case of coal we obtain approximately 100,000 B. T. U. for one cent, in the case of oil approximately 50,000 B. T. U. for one cent. So if the efficiency of the two were the same there would still be a saving of 50 per cent. in favor of coal. But we showed before that the gas engine has an efficiency of almost double that of the steam engine, so that if we were to use fuel oil in an engine and were able to buy that fuel at three cents per gallon as compared to coal at $3.00 per ton, there would be, from the standpoint of the cost of fuel, no difference between the oil or the explosive engine and the steam engine. But there is a commercial feature which should appeal to all engineers, namely, the fact that we are able with explosive to dispense with the services of firemen, coal passers, water tenders, etc., and that there is an undoubted large saving in weight and space. A first-class modern steam plant of large power, such as is used in transatlantic steamers of to-day, either with reciprocating engines or steam turbines, weighs approximately 135 pounds per I. H. P., or not over 14 I. H. P. per ton weight. We can construct an explosive engine on half this weight, and the only reason that the oil engine is not generally on board ship is due to the fact that the engine has not yet been developed for marine purposes, and the difficulty in obtaining oil fuel at all ports of call.

MARINE GAS SUCTION GENERATOR.

Recently there has been perfected in Europe apparatus which will eventually overcome the objection at present existing against gas engines on account of the limited amount of oil fuel and the difficulty of perfectly burning oil of the heavier types in an engine. This ap-

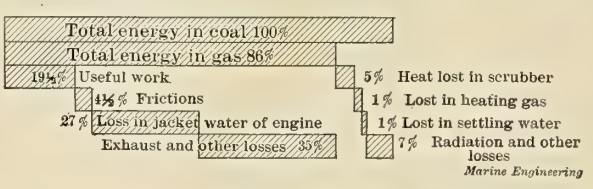

Total energy in coal 100%
Total energy in gas 86%
19½% Useful work
4½% Frictions
27% Loss in jacket water of engine
Exhaust and other losses 35%
5% Heat lost in scrubber
1% Lost in heating gas
1% Lost in settling water
7% Radiation and other losses
Marine Engineering

FIG. 3.—GAS PRODUCER AND GAS ENGINE.

paratus makes a fixed gas from coal, and this gas may be used in a gas engine to the same advantage that illuminating gas is used on land, and with the same degree of safety at present existing in the steam engine, with a consequent material reduction in operating expenses.

The gas producer has an efficiency of approximately 86 per cent., which would produce a horse power with an efficiency of 20 per cent. of the total heating value in the coal that is compared to 13 per cent. in the steam engine. Thus, for one cent, we are able to obtain 160,000 B. T. U. to be put into useful work with the same

amount of saving in labor as at present existing in the use of oil engines. These producers have been built to very large powers, in some cases to units of 2,500 horse power each, and with the development of the suction gas principle whereby the engine makes gas only as it requires, there should be in a short time developed a flexible marine engine using gas as fuel. It might be well here to explain a few points regarding suction gas producers. Chemically and physically the suction gas producer is no different than gas producers which are at present in use on land, inasmuch as the prime object is the burning of a sufficiently deep body of coal, converting the carbon in the coal to carbon monoxide, and reducing the amount of free nitrogen, by the introduction of steam, the decomposition of which enriches the gas. This forms a stable gas that need only be purified to properly burn. The main point of difference

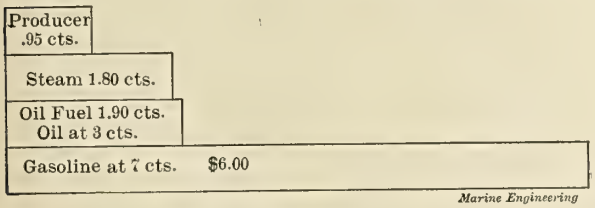


FIG. 4.—RELATIVE COST OF 1,000 H. P. PER HOUR.

between the suction gas producer and the gas producer manufacturing gas, is due to the fact that the physical properties of the gas engine whereby a charge of gas is drawn into the cylinder, compressed, burned and discharged, are used in directly operating the producer itself. As the suction stroke of the engine is sufficient to draw a charge of gas from the generator and allow free air and steam to replace the same and through the process of manufacture to make up the required equilibrium, this does away with some of the primary objections of gas plants, as the following features will show for themselves.

All the steam necessary in the manufacture of the gas is produced by utilizing the heat of the hot gas itself as it leaves the producer. This utilization of heat not only saves the fuel, which would otherwise be used under the boiler for producing the steam, but also cools the gases and aids in bringing them to the proper temperature for admission to the engine.

The absence of a gas holder saves a considerable amount of the first cost of the plant and reduces the floor space occupied.

No power fan or blower is required as the operation of the engine produces suction through the apparatus.

As the apparatus operates under negative pressure there is no possibility of gas leaking, and consequently no smell.

The plant can be started in from five to ten minutes, after which no further attention is required, except cleaning the grate and periodically filling the generator with coal.

These items named show that when an engine has been designed that will be flexible, in other words that will be self-sustaining, double-acting and reversible, there is no doubt but what a gas producer on board ship will prove both economical and feasible. An apparatus of this sort, even with the conditions existing to-day, weighs no more than the steam-engine plant of the same size and occupies less space, requires smaller coal capacity, and results in a large saving in maintenance, fuel, and wages. These facts should prove sufficiently interesting to cause marine engineers to give this subject their closest attention and to follow improvements likely to be made within the next few years in engines of the explosive type. Increased carrying capacity, decreased coal consumption, decreased wage account, and a consequent increase in dividends are the points to which all engineers are aiming at now.

The graphic illustration showing in dollars and cents the cost of a brake horse power for the various methods of operating plants taking a 1,000 H. P. clearly indicates the decreased cost of operation of the gas-producer plant.

German Shipbuilding Profits.

Shareholders in German ship yards have had little to complain of in their individual cash benefits from the past year's business. American investors in this class of industrials may well feel a little envious as they compare their own incomes from this source with those of their German brethren. For instance, the Vulcan Company, Stettin, paid a dividend of 14 per cent.; the J. C. Tecklenborg Shipbuilding Company, Bremerhaven, 12 per cent.; the G. Seebeck Shipbuilding and Machine Works Company, 10 per cent.; the Blohm & Voss Company, Hamburg, 9 per cent., and the Rickmers Company, Bremen, 7 per cent. In each of these instances the dividend was the same as that of the preceding year. Even where the dividends showed a decline, the stockholders have little cause to complain, from the viewpoint of Americans who will make invidious comparison. The Flensburg Shipbuilding Company showed a decline from 18 to 14 per cent.; the Reiherstieg Shipbuilding and Machine Works Company, Hamburg, from 13 to 10 per cent., and the Neptune Shipyard and Machine Works Company, Rostock, from 9 to 8 per cent.

In two instances the German companies showed a loss. The Bremer Vulcan Shipbuilding and Machine Works Company, Vegesack, suffered severe loss because of the necessity of writing off the books the shares of the Vulcan Belge of Hoboken and Antwerp, but this was not because of the decadence of its shipbuilding prosperity, and the present year will show a profit, it is said. The Howaldt Works Company, Kiel, did not pay a dividend, the available surplus having been transferred to a guarantee fund to provide for unforseen loss on a cruiser.

The gross tonnage of new shipbuilding showed a smaller gain than usual, which is accounted for to a great extent by the fact that fewer merchant ships and no war ships are being built on orders from other nations. It must be taken into consideration, however, in reviewing the prosperity of these shipbuilding concerns, that most of them have other lines of manufacture, such as general machinery and locomotives, in addition to ship construction.—*Iron Age.*

BATTLESHIP OHIO, ON OFFICIAL TRIAL, AUGUST 1, OFF PACIFIC COAST.

Trial Trip of the U. S. Battleship Ohio.

It is to be hoped and expected that the United States battleship *Ohio* will make her contract speed of 18 knots on a second trial. The probable reason for her failure to make full speed on her recent trial was due to her propellers, and to the fact that although originally designed for a 16-knot ship of 11,500 tons displacement and 10,000 horse power, the designs were later altered to secure a speed of 18 knots with 15,100 horse power. The usual designs of the Steam Engineering Bureau

TRIAL DATA. MARINE ENGINEERING DATA CARD. SEPTEMBER, 1904.

NAME—Ohio. TYPE—First class battleship.

LAUNCHED—1901. BUILDERS—Union Iron Works. OWNERS—U. S. Navy.

Length on load water line	338 ft.
Breadth, extreme	72 " 2 1-2 ins.
Draft, mean	23 " 6 "
Displacement	12,508 tons
Engines: number	two
Type	4-cylinder, triple
Cylinder diams	35 1-2, 53, 63 and 63 ins.
Stroke	48 "
Conde sers (2) combined surf	18,000 sq. ft.
Boilers	twelve Thornycroft
Working pressure	210 lbs.
G. S., total	925 sq. ft.
H. S., total	53,244 sq. ft.
Draft	Howden system
Propellers:	
Diameter	16 ft. 6 ins.
Pitch, adjustable, from 16 ft. 4 ins	
to 18 ft. 3 ins	17 " 3 "
Area, expanded	90 sq. ft.
" projected	75 " "
" midship section	1,625 " "
Ratio, pitch	1.06
" immersed midship section to expanded area	9.04

TRIAL DATA. MARINE ENGINEERING DATA CARD. SEPTEMBER, 1904.

NAME—Ohio. TYPE—First class battleship.

LAUNCHED—1901. BUILDERS—Union Iron Works. OWNERS—U. S. Navy.

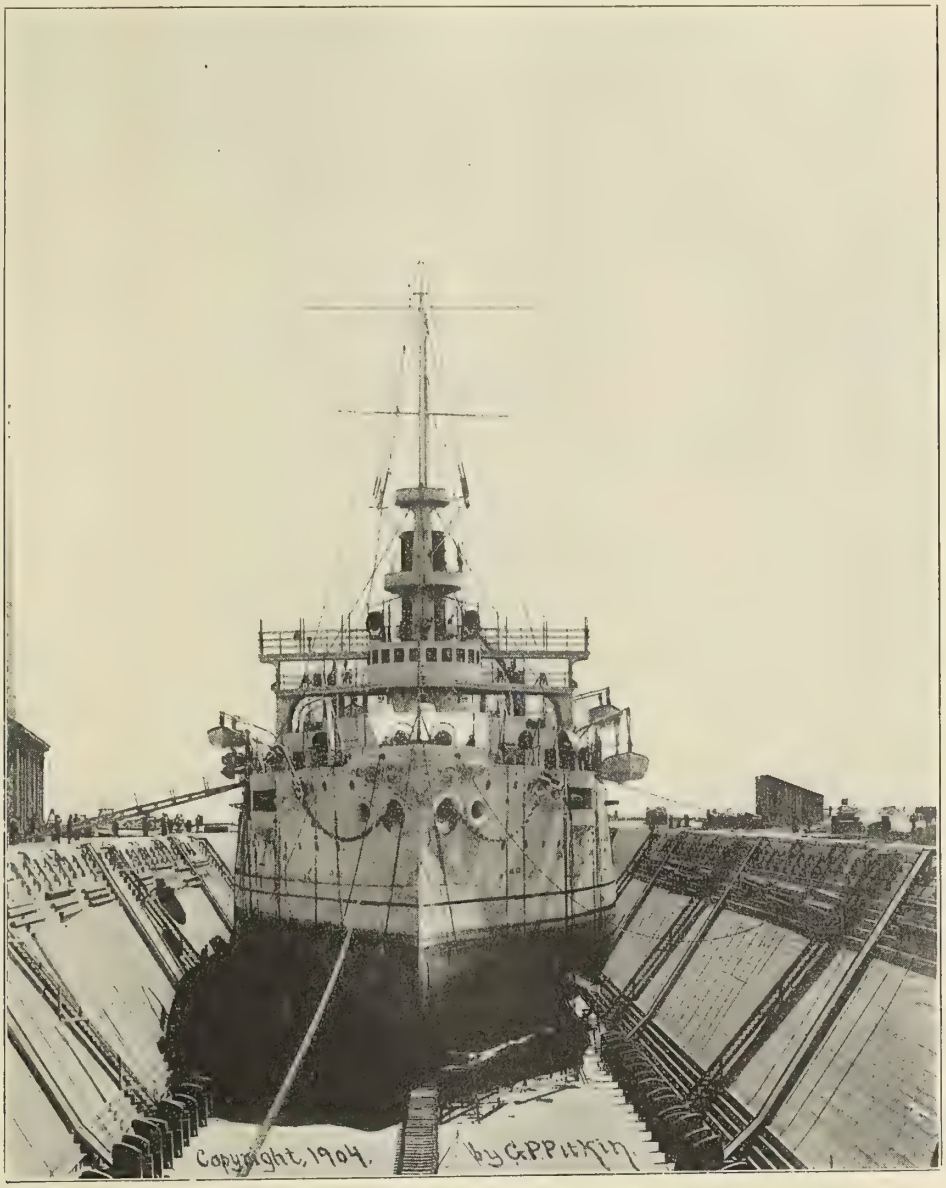
Trial:

	M. E. P.	H.P.	I.P.	Fwd. L.P.	A.L.P.
R. P. M. main engine, starboard, down, 124.08; up, 123.77					
Starb	61.75	40.25	17.95	17.23	
Port	72.25	44.02	17.03	16.88	
Rev main engine, port, " 123.91; " 123.68					
I. H. P., main engines					15,951
Pressure, steam					210 lbs.
" air circul. and feed pumps					268
I. P. receiver					80 to 90 "
" other auxiliaries					279
L. P. "					30 to 35 "
Total					16,498
Temperature, engine room					84 deg. F.
I. H. P., total ÷ G. S.					17.85
Fire room					106 "
H. S. ÷ I. H. P., total					3.23
Injection					68 "
Coal, lbs per hour " " I. H. P., total					32,637
Discharge					105 "
" " " main engines					2.05
Feed					120 "
" " " sq. ft. G. S.					1.98
					35.2

Cut off,	H.P.	I.P.	Fwd. L.P.	A.L.P.
Starb	.713	.717	.614	.616
Port	.715	.715	.611	.616

Speed, mean ..... 17.84 knots
Slip of propeller, apparent, mean ... 1 .3%
Admiralty coeff 192

were used for the two sets of main engines with dimensions as given in the table. The condensers are riveted steel-plate cylindrical type, each having 9,000 square feet of cooling surface. The air pumps are independent, vertical, single-acting, twin-beam, 12 and 25 inches by 20 inches stroke. There are two vertical single main feed pumps 16 and 12 1-2 by 18 inches stroke the area of each being 50.26 square feet, and the height above grates to top of funnel is 85 feet 6 inches. The Howden system of forced draft is installed and includes twelve 5 and 8 by 6-inch compound engines direct connected to centrifugal fans. When running at 800 revolutions they have each a delivery of 24,000 cubic feet of air per minute.



U. S. BATTLESHIP OHIO, IN DRY-DOCK, PREVIOUS TO RUNNING OFFICIAL TRIAL.

which supply the boilers, and the hot-well pumps are duplicates of the main feed. The auxiliary feed is provided for by four 14 and 10 by 8-inch vertical single pumps.

The boiler plant includes twelve Thornycroft boilers constructed for 210 pounds of steam, each containing 1,210 tubes, 1 3-8 inches in diameter and No. 9 B. W. G These boilers are fitted with automatic water regulators and are capable of raising full steam from cold water in twenty or thirty minutes. There are three funnels,

The original propellers designed for the *Ohio* were as follows:

Diameter	15 ft. 6 ins.
Pitch, entering	15 " 6 "
" trailing	18 " 6 "
" adjustable from 16 ft. 6 ins. to 18 ft. 6 ins. mean pitch.	
Developed area	68 sq. ft.
Projected "	56 " "
Pitch ratio	1.13

The area of immersed midship section is 1,625 square feet, giving a ratio of immersed section to developed area of 11.91. These propellers were substituted for those of less pitch but greater area, as shown in the accompanying data card.

On Monday, August 1, 1904, the *Ohio* left Santa Barbara, and at 7:21:40 A.M. entered the trial course, coming off at 9:21:10. The turn took 7 minutes 55 seconds, and she re-entered the course at 9:29:5 and came off at 11:31:50. With tidal and wind correction the ship's official time was 17.84, or .16 knots short of the requirements.

Although the boilers carried full pressure, and the valves were blowing at times, the required turns could not be obtained from the engines, indicating that the propeller was at fault. The coal used was Harris hand-picked navigation, and give satisfaction.

An instrument worthy of particular notice was the fire-controlling device. Each furnace was numbered, and when the time came to fire that furnace, the number was illuminated on a dial by automatic electrical clockwork controlled from the engine room; thus regular firing was obtained at any desired rate. This is very important with these boilers.

After the trial, under orders from Admiral Whiting, the ship executed many manœuvers, trying her hydraulic steering gear, which worked very satisfactorily.

The high-pressure cylinder and piston rings were found to be scored, and two piston rings broken. The babbitt melted out of one blower engine, and out of the intermediate-pressure crank pin. The latter was the cause of loss of time, and may have been due to the fact that the intermediate cylinder was developing 1,200 more horse power than the others.

It is expected that the *Ohio* will make her time after passing into commission and receiving new propellers. It is also expected that the naval engineer will gradually substitute the navy standard babbitt for that now in use, in all bearings. "E. P. N."

High-Pressure Centrifugal Pump Tests.

Under the direction of Messrs. William Kent and J. E. Denton, complete tests were made on three high-duty centrifugal pumps built by the De Laval Steam Turbine Company, at the company's works in Trenton, N. J. The object of the tests was to first measure the efficiency of each pump over a range of heads and water delivery sufficient to determine the maximum efficiency, and, at the same time, show that a pump may be designed for any amount of lift and water delivery at maximum efficiency. Second, to determine the economy of the steam turbine-driven pumps as measured by the difference in millions of foot pounds per thousand pounds of commercial dry steam. Third, to provide the means of determining the economy of one of the pumps which was electrical driven.

Each pump was arranged to lift water about three feet from a storage tank in the floor of the testing room, and to deliver it to a Weir tank through a throttle valve at the outlet of the pump case, and thence through a short pipe to a vertical converging nozzle with outlet located above the Weir tank. The quantity of water passing the nozzle was determined both by a Pitot tube and by means of the Weir. The total head pumped against is the sum of the suction and delivery pressure expresed in feet head of water. Both these heads were determined by pressure gauges. To increase or decrease the head during the different tests, the throttle valve above mentioned in the delivery pipe was partially closed or opened.

The Weir and Pitot tubes were carefully calibrated before the tests, and constants or corrections made for all apparatus used. The steam consumed was measured by exhausting the turbines into a surface condenser and weighing the condensed steam. After the tests the pumps were disconnected from steam or electric motors and Prony brakes substituted to absorb the power.

PUMP TEST NO. I.

The first pump test was a single-stage centrifugal pump, without stationary outlet guides, designed for a delivery of 1,700 gallons per minute and a lift of 100 feet when running at 1,545 revolutions per minute. This pump was driven by a De Leval 55 horse power steam turbine by direct connection with its geared shaft. Its diameter dimensions were as follows: Suction and discharge, 8 inches; pump wheel, 13.75 inches.

This pump delivered a maximum quantity of 1,978 gallons per minute against a total lift, including suction, of 46 feet, the delivery decreasing to 1,759 gallons per minute for a total lift of 100 feet and to 1,001 gallons per minute for a lift of 126 feet. When the delivery valve was shut, the maximum pressure shown was equivalent to a lift of 142 feet with no delivery. The water horse power of the pump was at a maximum of 44 1-2 horse power for a delivery of 1,760 and 1,860 gallons and corresponding to lifts of 100 and 95 feet, and the horse power decreased when the delivery was either increased above 1,860, with diminishing head, or was decreased below 1,760 gallons with increasing head. The efficiency of the pump, which is the ratio of the water horse power to the calculated brake horse power, ranged from .743 to .756 for delivery between 1,398 and 1,86c gallons per minute, decreasing as the delivery was either decreased or increased beyond these limits. The duty of the pump when the turbine was running condensing ranged from 60 to 61.86 millions of foot pounds per 1,000 pounds of steam within the same limits, decreasing to 54.47 million foot pounds for a delivery of 1,001 gallons against a total lift of 126 feet, and to 37.43 millions at the maximum delivery of 1,978 gallons per minute against a total lift of 46 feet. Three tests were made with the turbine running non-condensing, which gave a duty ranging from 44.6 to 45.15 millions, for deliveries of 1,629 to 1,826 gallons, and total heads respectively of 104.42 and 95.14 feet.

The steam per brake horse power, running condensing, ranged between 24.06 and 24.53 for delivery between 1,398 and 1,860 gallons per minute, corresponding to heads of 115.5 and 95 feet. These deliveries and heads therefore cover the economical range of the pump, and show that the conditions for which it was designed coincide with those of maximum efficiency.

PUMP TEST NO. II.

This was a single-stage pump without stationary outlet guides, driven by direct connection to a 20 horsepower, direct-current electric motor, designed for 1,200 gallons per minute delivery, a lift of 45 feet, and 2,000 revolutions per minute. The diameter dimensions of

this pump were as follows: Suction and discharge, 8 inches; pump wheel, 8.3 inches.

The tests of this pump showed a delivery ranging from 790 to 1,403 gallons per minute at total lift heads respectively of 59 and 30 feet. The electrical horse power was 20.11, or 17.14 brake horse power, for the smallest delivery at the highest head, and 17.80 electrical horse power, or 14.94 brake horse power, for the largest delivery at the smallest head.

The maximum electric horse power, or 17.72 brake horse power, was attained at a delivery of 986 gallons per minute, and a total head of 53 feet. The efficiency of the pump, which is measured by the quotient of the water horse power divided by brake horse power, ranged from .714 for the maximum delivery of 1,403 gallons a minute to .750 for a delivery of 1,133 gallons, falling to .683 for the minimum delivery of 790 gallons a minute at the highest head of 59 feet. Four tests of this pump were made with the suction throttled to a constant suction lift of 20 feet to determine if the throttling made any change in the efficiency. With throttled suction, the range of efficiency was .655 to .733, showing a decreased efficiency of only about 2 per cent.

PUMP TEST NO. III.

The third test was of a two-stage pump without stationary outlet guides, for high pressures, designed for a delivery of 250 gallons a minute, and lift of 700 feet, the large pump wheel driven at a speed of 2,050 revolutions per minute by direct connection to the geared shaft of a De Laval steam turbine, and the small wheel at 20,500 revolutions per minute by direct connection to the high-speed shaft of the motor. The diameter dimensions of this pump are as follows: Low-pressure, suction and discharge, 6 inches; pump wheel, 9 inches; high-pressure, suction, 6 inches; discharge, 4 inches; pump wheel, 2.84 inches.

The results of this test show a delivery of from 244 to 373 gallons per minute against heads respectively, of 781 and 136 feet. The water horse power increased from 12.83, corresponding to 373 gallons delivered at 136 feet head, to 48.15 for 244 gallons delivered at 781 feet head. The duty in million foot pounds was a maximum of 48.88 for delivery at the highest head and decreased to 41.55 for 328 gallons delivery at 494 feet head, and to 18.63 millions for the maximum delivery of 373 gallons at the head of 136 feet. The steam per water horse power per hour ranged from 40.5 for the maximum horse power and highest head to 106.2 for the maximum delivery, lowest head, and lowest horse power. This lowest horse power is only about one-fourth of the highest horse power delivered by the pump. Both the electrical and two-stage pumps therefore realize their maximum efficiencies at practically the designed conditions of lift and water delivery.

New Pacific Steamship Minnesota.—The *Minnesota*, the largest steamship in commission flying the American flag, left her builders' yard, the Eastern Shipbuilding Company, New London, Conn., on August 20, and proceeded to New York, where she was open to inspection. Later the *Minnesota* was to sail to Norfolk for docking and a cargo of coal, and will then proceed to the Pacific. A complete description of this ship was given in Marine Engineering for May, 1903.

Scout Ships for the Navies.

The first of the British scout ships, the *Sentinel*, is nearing completion at the works of Vickers Sons & Maxim, Ltd. Much interest is centered on this new type of ship developed at the British admiralty. The length is 360 feet, breadth 40 feet, normal draft 14 feet 2 inches, corresponding displacement, 2,920 tons. The ship is to be fitted with two sets of reciprocating engines of a collective horse power of 17,000 I. H. P. and according to the contract, on a trial trip of eight hours' duration, the speed of 25 knots is to be maintained. The armorment consists of ten quick-firing, 12-pound guns and two torpedo tubes.

The last congress made appropriation for three scout ships for the United States Navy of not more than 3,750 tons trial displacement, to have the highest speed compatible with good cruising qualities and great radius of action, at a cost not to exceed (exclusive of armorment) $1,800,000 each. Plans of these ships have not as yet been sufficiently developed to set the exact dimensions nor are, as yet, the machinery details positively decided upon. However, under the direction of Rear Admiral Charles W. Rae, engineer-in-chief, plans are being prepared for reciprocating engines in one of the three ships, the other two to be equipped with steam turbines, which probably will be chosen from different types.

It is likely that the transmission of the power in the turbines will be arranged for on two, or four shafts, to revolve at about 350 revolutions per minute in the former case and at about 475 in the latter. There will only be one propeller on each shaft.

The water tube boilers are being designed for 250 pounds steam pressure, which will be used by the reciprocating engines, the turbines to be supplied at the reduced pressure most suitable for the particular type installed. Superheating of the steam will probably not be specified (although its advantage in connection with steam turbines is well recognized), it seemingly being impossible to obtain suitable superheaters without excessive complications and increased weight, which in this instance is particularliy undesirable.

The condensing apparatus for the turbine installations is figured on a basis of 50 per cent. increase in surface over the reciprocating engine outfit, but nevertheless it is expected that the total weight of, as well as the space occupied by the turbine installations, will be well within the limits allowed for the reciprocating engine arrangement.

Steamer Wolvin's Unloading Record.—The giant great lake steamer *Augustus B. Wolvin*, recently established a record for unloading iron ore at Conneaut, Ohio. The ship was under the unloading machines for 4 hours 30 minutes. The four Hulett machines were in operation for 4 hours and 6 minutes, during which time they took out 7,057 gross tons of ore. The average time that the Brown electrical machines were working was 3 hours 41 minutes, removing in this time 2,688 gross tons. Fifty men were employed in the hold of the ship, working the ore away from the sides of the vessel to the unloading buckets. They had practically nothing to do until the last hour, as the buckets were operating in sufficient ore to dip full loads.

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DETAILS of the naval battles of August 10 and 14 are received with absorbing interest in all naval circles, and while the reports of the experts, assigned by the neutral powers to observe the movements of the fleets have not as yet been received, or made public, the later press dispatches furnish the basis for most interesting observations. In the first stages of the war the daring and brilliant performances of the Japanese torpedo boats caused a feeling that this small and dangerous type, in conjunction with the submarine, would decide future engagements. The awe which the presence of these vessels inspire in an enemy's fleet, is already well understood—that at any moment a battleship of the latest type might be struck by a torpedo discharged in the dead of night, from an unseen foe—and the early incidents of the war proved the value of these two types and the submarine and floating mines under certain conditions.

The battles of Korea Bay, August 10, and the Straits of Korea, August 14, throw a different light on the relative value of warships of different types. In the first engagement, the entire Port Arthur squadron under Admiral Withoft, while endeavoring to escape to the southeast, was attacked by Admiral Togo. The battle was fought at ranges reported to be from three to five miles, therefore, one in which the heavy guns alone could be used. The fire of the Japanese was most deadly and accurate and nearly all of her enemy's ships were severely damaged, the formation of the squadron was broken up and the ships escaped as best they could under cover of the night, some, including the battleships, back to Port Arthur, and the rest to neutral ports from Tien Tsin, in China, to Saignon in French Indo China. Toward the end of the battle the Russians endeavored to close in, but the Japanese admiral would not permit it. The pursuit of the fleeing ships was left to the Japanese destroyers and the flagship *Mikasa*. Several torpedoes were discharged but none took effect. Although the battle was not a decisive one, so much damage was inflicted upon the Russians that those vessels which returned to Port Arthur may probably not be repaired before the fall of that fortress, and those which reached neutral ports are either being dismantled, or affording the basis for international contention in respect to the observance of neutral ports. The armored cruiser *Novik* of this squadron, which escaped to Tsing Tau, was later intercepted by the cruiser *Tsushima* while endeavoring to effect an entrance to Vladivostok, around the north of Japan, and was practically annihilated.

The engagement in the Straits of Korea, when the Japanese squadron of armored cruisers, under Rear Admiral Kamimura, overhauled the three largest cruisers of the Vladivostok squadron, was also at long range. The superiority of speed of Kamimura's vessels is well worthy of mention. The *Rurik, Gromoboi* and *Rossia,* the Russian vessels, had been in the navy yard with but brief exceptions, ever since the war began, and are rated at greater speed than the Japanese ships, which for several months had maintained vigilant watch in the Sea of Japan. The *Rossia* was sunk, but the two other ships escaped to Vladivostok in a badly cripled condition. Several times during the engagement fire broke out on all three of the ships, the carnage caused by exploding shells made the decks a veritable shambles. Forty per cent. of the officers and crew of the Russian cruisers were killed or wounded.

A comparison of the fighting value of the opposing fleets must naturally take account of the

men behind the guns. While the brilliancy and dash shown by the Japanese have no counterparts in Russian records, the great courage and heroism of both contestants may be considered as equal. The Japanese have proved themselves expert marksmen. The effectiveness of long range, accurate firing, has been most forcefully demonstratd. Like the Spaniards in the battle of Santiago, the Russians are reported to have been practically smothered by the terrific, deadly firing of the Japanese, to which they were unable to make adequate reply. The surprising superiority of speed of the Japanese ships, by which their commanders were able to choose their distance and out-manœuver the Russians, is indeed remarkable. The engagements show that the battleships and armored cruisers can stand up to fearful canonading, for while the hulls were many times pierced, the fighting efficiency of the ships was but little effected. Little damage was done to the propelling machinery, but the upper works were fairly riddled and the unprotected guns or gun mechanism rendered unfit for firing. On the *Rurik* every unarmored gun was dismantled and most of the gunners killed, yet it is reported that not one of the gunners fighting behind armor emplacements was killed. The fighting value of the heavily armored ships has been conclusively demonstrated.

Again it is proven that the most effective protection of a ship is its own deadly fire upon the enemy. The damage sustained by the Japanese was slight; none of their vessels were placed *hors de combat,* and the loss of life on board was very small. The ability of the Japanese to maintain their squadrons at sea in such splendid condition, ready for an onslaught at any moment, to show such remarkable accuracy of gun fire, and superior ability in manœuvering their ships, places them among the foremost naval powers.

ON another page we present in full the official report of the Committee on Naval Boilers, appointed four years ago by the Lords Commissioners of the Admiralty to investigate the several types of water-tube boilers, with a view of recommending to the Admiralty one type best suited for British warships. We have from time to time printed and commented on the several preliminary reports of this commission, which, it will be remembered, was appointed at the time when the value and efficiency of the Belleville boiler, the then only make of water-tube boiler fitted in large-size British warships, was seriously attacked. Although the Committee adheres to its previously expressed opinion that it is "undesirable to fit any more of this type in His Majesty's Navy," it must be remembered that since then many new types have been developed, tested and perfected, and also that many Belleville installations are giving satisfaction.

Two years ago the Committee expressed the opinion that there were four types of water-tube boilers, the Babcock & Wilcox, Niclausse, Dürr and Yarrow large-tube, which appeared sufficiently promising to warrant use in the navy, and it is to these that the Committee's later investigations were directed. Each type was installed on one or more warships and subjected to exhaustive tests at different rates of combustion. The Committee unreservedly recommends the Babcock & Wilcox and the Yarrow large-tube for use in large warships.

With respect to thermal efficiency, the latest installation of the Babcock & Wilcox boiler on board the *Hermes* reached the high figure of 81 per cent. on a thirty hours' trial, when burning 20 pounds of coal per square foot of grate per hour, while the maximum efficiency for the Yarrow boiler on the *Media,* viz.: 75.7 per cent., was obtained on a twenty-six hours' trial when burning 18 pounds per square foot of grate per hour. Careful record was made of the wetness of the steam and loss of water, and the two types of boilers recommended gave satisfactory results, the Committee observing that in those boilers fitted with many covers or hand holes, the loss in water may be expected to be greater. In regard to external and internal cleaning of tubes and corrosion, the Babcock & Wilcox and Yarrow types are preferred. It was noticed that in tests of the other two types, in which the tubes are supported at the front end only, the lower tubes were considerably bent upward at the rear. As considerable trouble resulted from the use of automatic feeds, the Committee recommends those boilers in which this device is not necessary, the Yarrow and the Babcock & Wilcox. An interesting table is given in the report concerning weight and output of each boiler, which needs no comment here. Officially this report, because of the high standing of the members of the Committee, and the exhaustiveness of its researches, may be looked upon as one of the most valuable contributions to the engineering profession, and it is cause for congratulation to the successful American builders that their boiler should thus be selected.

Engines of H. M. S. Prince of Wales.

The engines of the new H. M. S. *Prince of Wales,* a first-class battleship of 15,000-tons displacement, were built by Messrs. Scott & Company, Greenock Foundry, Scotland.

There are two similar sets of triple-expansion engines arranged in separate water-tight compartments, each engine being capable of developing 7,500 indicated horse power, or a total of 15,000 indicated horse power. Each set of engines has three cylinders, the diameters being, high-pressure 31 1-2 inches, intermediate-pressure 51 1-2 inches, and the low-pressure 84 inches, arranged in the usual manner, and all having a stroke of 51 inches. The cylinders are fitted with cast-steel pistons and covers; the high- and intermediate-pressure cylinders have forged steel liners, whilst that of the low-pressure is of hard, close-grained cast iron. All the cylinders are steam jacketed. The slide valves for the distribution of steam are of the piston type for the high- and intermediate-pressure cylinders, and those for the low-pressure are of the flat, double-ported type, with a relieving ring at the back. The cranks are set at an angle of 120 degrees with each other. The crank shaft is made up of three interchangeable parts, the diameter being 17 inches external and 9 inches internal. The shafting throughout is hollow, and is made of forged steel. The back columns are of cast iron, and the framing of the engines of cast steel. The front columns are round and of forged steel polished. The propellers have a diameter of 17 feet 6 inches and 19 feet pitch, with detachable blades of manganese bronze. The exhaust steam of the main engine is condensed in four large gun-metal condensers, two in each engine room, which have a total cooling surface of 16,000 square feet, and are so arranged that they can be used independently. There are also two auxiliary condensers, one in each engine room, with a total cooling surface of 2,400 square feet, for condensing the exhaust from the auxiliary engines. The auxiliary machinery is of the usual type. An independent air and circulating pump is used for each auxiliary condenser, while the main air pump is worked in the usual way from the crosshead of the main engines.

The boilers are of the Belleville type, and were also made at Greenock, and they contain all the latest improvements. There are twenty in all, fifteen consisting of ten elements and five of nine elements, all with economizers arranged in their separate boiler rooms. The working pressure is 300 pounds per square inch, reduced to 250 pounds at the main engines. The total heating surface is 37,040 square feet, and the grate area 1,170 square feet. The air is supplied to the furnaces by three large air-blowing engines. The stoke holds are ventilated by ten fans, two in each stoke hold, driven by inclosed steam engines. The ventilation of the engine rooms is affected by two electric motor fans.

The machinery trials were successfully completed last December. The table below gives the principal results. —London *Engineer.*

Nature of trial.		Mean pressure in cylinders.						Mean I. H. P.		Total I. H. P.	Coal consumption per I. H. P. per hour.	Boiler pressure, pound per square inch.	Speed in knots per hour
Power.	Hours.	High.	High.	Inter.	Inter.	Low.	Low.						
		P.	S.	P.	S.	P.	S.	P.	S.		Lb.		
1-5	30	39.3	41.8	15.4	12.3	5.3	5.8	1 583	1,545	3,128	2.21	221	10.45
3-4	30	97.1	97.3	34.3	30.8	13.7	12.3	6,038	5,631	11,669	2.08	267	17.043
Full.	8	105.7	105.8	41.4	38.8	17.5	17.9	7,721	7,643	15,364	2.02	286	17 87
1-2 power after opening out.....		69.3	74.6	27.7	27.0	10.8	9.4	4,152	3 983	8,135	....	248	14.6

Water consumption per I. H. P. per hour (all purposes) = 19.0 pounds on full power trial.

The Resistance of Some Metals to the Action of Sea Water.

The following observations from a detailed description of the tests made by Mr. Diegel to determine the resistance offered by metals to the corrosive action of sea water, appear in *Stahl und Eisen,* and were condensed by the *Engineering Press Monthly Index Review.*

These metals consisted of bars and plates of different compositions and alloys used in shipbuilding. After having determined their weight, chemical composition, etc., they were immersed for several months in Kiel harbor; on being re-examined their respective resistances were established.

Two alloys of nickel and copper (containing respectively 42 per cent. and 6 per cent. of nickel) suspended separately were effected by corrosion to about the same degree. These same alloys being suspended together with other metals were more or less proof to the action of sea water, owing to the influence of these metals; the alloys least effected were those nearest the iron.

Alloys of common copper suspended with alloys of copper and nickel were sensibly more effected. Other tests established the fact that an addition of 15 per cent. of nickel to the alloys of copper and zinc considerably increased the resistance.

The author then gives in tabular form a statement of the resistance of different metals; from this it appears that the greatest loss in weight takes place in the case of iron, the smallest in the case of copper.

On the other hand iron protects other metals and alloys against the corrosive action of sea water, even when it is not in direct contact with them.

Two qualities of copper—one pure, the other impure—being tied together, it was found that the pure copper suffered more; suspended apart, however, the same corrosion took place.

Mr. Diegel then gives numerous tests made to determine the influence which phosphorus and nickel contained in iron exerts on the corrosion of this metal.

Previous tests had testified to the non-influence of

phosphorus. But owing to the conditions under which they were carried out there was certain reason to doubt the exact results. One test, among others, made with the tubes of a locomotive furnace showed that those containing 1 per cent. of phosphorus resisted better than those containing 2 per cent.

This strange result led to further investigations; at first two iron pieces tied together were suspended in water. One of these pieces contained a large quantity of phosphorus, the other practically none. After some time it was observed that the piece rich in phosphorus was well preserved, the other being very much damaged.

Other tests have confirmed these results and a loss in weight from 3 to 6 times greater is shown for iron containing but little phosphorus.

Tests made simultaneously with two qualities of nickel steel (containing 6 and 30 per cent. of nickel) showed that the steel richest in nickel suffered least. Suspended apart, the loss in weight was also less sensible for steel containing a large quantity of nickel. Having then measured the differences of potential pressure of these metals and alloys it was found that these differences were proportional to the degree to which they are effected by corrosion.

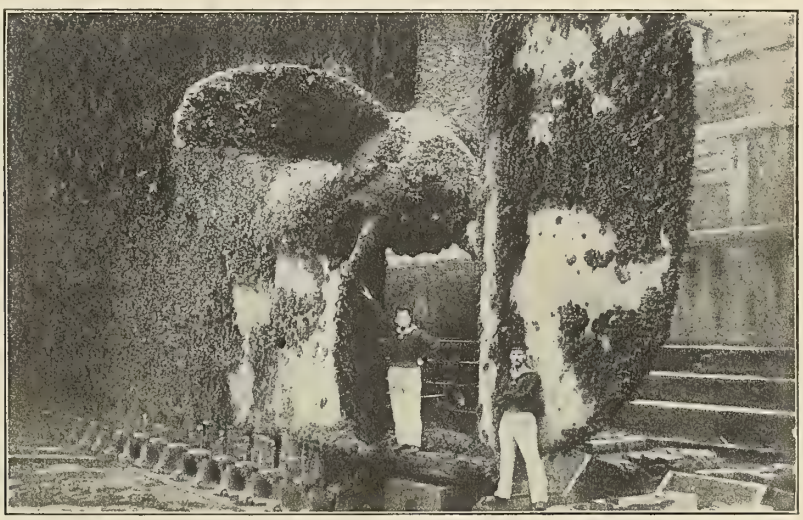
The author terminates by citing several conclusions arising from his study: all parts of the body of a ship or of a marine boiler in contact with water should be as far as possible constructed in iron containing the same quantity of phosphorus. If some parts must be particularly built so as to resist attack, they should be constructed in iron rich in phosphorus or in nickel; in this case the parts in the immediate vicinity must suffer a more intense corrosion. The use of steel containing a large quantity of nickel must be avoided in places in which they would be in contact with metals, the tensions of which are nearer that of the copper than the steel itself actually is.

The above rules, however, it must be understood, are not admitted to be applicable to steam boilers.

Lloyd's Shipbuilding Returns.—For the quarter ended June 30, 1904, Lloyd's Register reports that excluding warships there were 392 vessels of 993,088 tons gross under construction in the United Kingdom. This is an increase in construction of about 4,500 tons more than at the end of the previous quarter, and a decerase of about 35,000 tons from that of the corresponding quarter of a year ago.

Merchant Marine Commission.—Four members of the Merchant Marine Commission, appointed by congress to investigate the conditions of the American merchant marine, held sessions on July 26 and 27 at Seattle. Many suggestions were made by prominent Pacific coast men as to the best ways and means of improving our merchant marine.

Engineer Draftsman.—The United States Civil Service Commission announces that the examination for engineer draftsman in the supervising architect's office, announced for August 17, 18 and 19, has been postponed to September 14, 15 and 16, 1904, and will be held at the large cities to secure eligibles from which to make certification to fill a vacancy in the position of engineer draftsman in the supervising architect's office, at $1,200 per annum, and other similar vacancies as they may occur in that office. Applicants should at once apply either to the United States Civil Service Commission, Washington, D. C., for copies of application form 1312.



BARNACLES ON THE GERMAN WARSHIP KAISER FRIEDRICH AFTER A SOUTHERN CRUISE.

Turbine Steamer on Lake Ontario.—The first turbine steamer to go into regular business on this side of the Atlantic is the *Turbinia*, which is to make three round trips a day on Lake Ontario between Hamilton and Toronto. This *Turbinia*, not the first of the name, was built at Newcastle, England, having been begun January 4 and launched on March 30. She left Newcastle June 1, sailing around the north of Scotland, and went from land to land in six days. She went up the St. Lawrence, passing through the several canals (which limited her dimensions when designed), and arrived at Hamilton June 19. She is 260 feet long, and her engines are rated at 4,000 horse power. Her contract speed was 20 miles an hour, but she is reported to have made 22 1-2 on trial.

QUERIES AND ANSWERS.

Q. 222.—For the purpose of deciding an argument, will you please advise if there is a steam hammer in existence so large that while in operation the vibrations cause windows to be broken in houses half a mile away?

A.—We have been unable to learn of any hammer which causes such disastrous vibrations as you mention. The largest hammer ever erected in this country was at the plant of the Bethlehem Steel works, but soon after it was put in operation, several years ago, the process of forging heavy ingots was changed, and now hydraulic presses are used. Upon inquiry, the Fred. Krupp works at Essen Ruhr, Germany, advise us that their large hammer produces but little vibration.

Q. 233.—Will you please answer in your Q. and A. column the following questions:

We have a boat 85 by 10 by 6 feet; engine, two high-pressure cylinders 8 1-2 and 8 1-2 by 8 inches; propeller, 4-bladed, 40 inches diameter by 70 inches lead; can turn it (single screw) 670 revolutions, at which speed we have covered a course of 3 1-2 miles in 20 minutes, current about 5 miles an hour. Can we get a faster rate of speed if we should put a wheel on that has a greater pitch (we cannot increase the diameter), and turn it slower, say 350 revolutions? What size and kind of a wheel would you advise? Any information will be greatly appreciated.

S. J. H.

A.—The data which you give are somewhat uncertain in meaning. The 6 feet may be either draft or depth of boat, and it is not clear whether according to your figures the speed of the boat through the water was 10 1-2 or 15 1-2 or 7 1-2 miles per hour. Furthermore, you do not state the steam pressure which you carry, so that any estimate of the horse power developed is simply guesswork. According to the steam pressure which you might employ you should develop at 670 revolutions per minute anywhere from 150 to 200 I. H. P. or more. If then your boat has a mean draft of about 4 feet and a displacement of about 50 tons, you should be able with somewhere about the lower amount of power to reach a speed of 15 or 15 1-2 miles through the water. With deeper draft and more displacement the power required for this speed would be correspondingly more.

In any event, with 670 revolutions, it does not seem likely that you are developing much less than 150 I. H. P., and presumably more; and to take care of this at a speed of 15 1-2 miles, a propeller somewhat as follows might be employed, provided your diameter is limited to 40 inches:

Diameter	40 ins.
Pitch	52 "
Revolutions	400
Number of blades	4
Average width of blades	9 ins.
Maximum " " "	about 10 "
Surface area	600 square "

A propeller of 40 inches diameter is, on the whole, too small to absorb this power with good efficiency at this speed, and a diameter of 4 feet with pitch about 5 feet and revolutions about 350 would be much more suitable. If, however, the diameter cannot be increased, some such propeller as above would represent about the best combination available. If you are developing more power or if your speed is less than 15 1-2 miles, then you should have a larger propeller, and any attempt to realize satisfactory conditions on a diameter of 40 inches is entirely useless.

Your present performance, as stated, seems entirely inconsistent with the results to be expected from properly-designed propellers and operating under usual conditions. Your revolutions are 670 and pitch 70 inches. At a speed of 15 1-2 miles this figures out a slip of 65 per cent. This seems an improbable value under the circumstances, unless your propeller is very deficient in area. If correct, however, it indicates a propeller totally unfitted to its work, and a tremendous loss of efficiency. Under such conditions it seems likely that any changes in the propeller in the direction of decreased pitch and if possible increased diameter, with perhaps increase in area, are likely to prove beneficial, and to give results more nearly in accord with those to be expected from propellers of standard form operating under normal conditions.

Q. 238.—Being highly interested in the able article concerning two-cycle motors, by Mr. H. B. Maxwell, published in May Marine Engineering, I beg to enquire what changes in parts and general construction will be necessary to secure 1,000 revolutions per minute in the motor illustrated; and also, if by exchanging the position of the base plate with one of the hand holes, the engine can be placed horizontally and run in a horizontal position equally as well as in the designed vertical position, and if so, which side would be preferable to use as base? G. E.

A.—It will be found that the ports as shown in the drawings in May issue are large enough to admit of a speed of 1,000 R. P. M. The spark lead should be greater than for the normal speed.

In making a horizontal engine it would be advisable to have the left-hand side as shown on page 219 of May issue for the bottom as it is preferable to have the transfer port on top.

We would suggest having one hand hole about twice as long and have its center about 45 degrees above a line through crank shaft and the center of cylinder.

Q. 239.—Some years ago I purchased a tug boat, and during my ownership of several years, I never had the check valves refuse to work, and upon examination I found two check valves in the feed pipe (one horizontal and one perpendicular). I suppose thus having two check valves obviated the necessity of regrinding valves into their seats. By thus using two check valves is the strain on the pump thereby increased beyond the actual weight of the second valve, which has also to be lifted to allow ingress of feed water into boiler?

I am a recent subscriber to Marine Engineering, and I think your decision regarding the matter aforementioned will settle a disputed point between several engineers in our city.

O. S.

A.—The strain on a feed pump due to lifting the check valve is somewhat greater than that due to the mere weight of the valve. The inertia of the valve must be overcome, and at high pump speeds this may form a considerable addition to the actual weight to be lifted. There does not appear, however, to be reason for assuming any increase in the load on the pump due to the second valve, beyond that due to its intermittent motion of rise and fall, and under ordinary conditions this should not form any appreciable part of the load on the pump.

The practice of putting two check valves on the line between feed pump and boiler is by no means rare, though in common practice and with standard forms of valve, one is usually found sufficient.

Q. 240.—I am thinking of building a triple-expansion engine, cylinder's diameter, 4, 7, 11, by 7 1-2 inch stroke. Could you give me size of steam ports, exhaust ports, and lap of valve? also lead of valve on each cylinder? This is for a steam launch.

A.—The maximum speed of steam through steam pipe passages and ports has been limited to certain values ascertained by experience. In a triple expansion engine the several values are as follows:

Speed of steam in pipe, about 7,500 feet per minute.

Speed of steam through ports (during exhaust) H. P. 5,800.

Speed of steam through ports (during exhaust) I. P. 7,200.

Speed of steam through ports (during exhaust) L. P. 8,600.

For the exhaust passages from one cylinder to the next the values are somewhat smaller.

In designing an engine it is necessary to know the revolutions desired, as the piston speed, as well as the size of cylinders determines the port area. In your case we assume 400 revolutions per minute, giving a piston speed of $\frac{7.5 \times 2}{12} \times 400 = 500$. Taking the above figures as the allowable speed of steam through the respective ports, we first find the volume of steam required for the cylinder by multiplying piston speed by cylinder area, and then dividing allowable speed through the ports by this product. Thus, for the high-pressure cylinder the area of the port is as follows:

$$500 \times 12.6 = 6{,}300.$$
$$6{,}300 \div 5.800 = 1.09 \text{ sq. in.}$$

Similarly the areas of the intermediate and low-pressure ports are found to be 2.68 and 5 square inches, respectively.

The lead on the high and intermediate cylinders should not be above 1-16 inch at the top and on the low-pressure cylinder not more than 3-32 at the top. For a high-speed engine, the exhaust lap should be such that the valve commences closing the port at about 85 per cent. of the stroke.

Q. 241.—I submit herewith a formula which I have used in the design of many propellers for launches with satisfactory results.

Let P = pitch of propeller in feet,
D = diameter " " "
R = revolutions per minute,
A = area = $D^2 \times .7958$,
W = weight of 1 cu. in. water = .0361 for fresh water and .0371 for salt water.

Then $P = \frac{\text{I. H. P.} \times 33{,}000}{A.\ W.\ R.}$.

F. M. M.

A.—The constant in A should be .7854 instead of .7958. We understand that this formula is submitted for discussion or comment regarding its applicability to the solution of problems in propeller design. To this end we may change its form slightly as follows:

$$I.\ H.\ P. = \frac{P.\ R.\ A.\ W.}{33{,}000} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1).$$

or, since W and 33,000 are constants, and since A varies as D^2, the square of diameter, we may write the relationships involved in the formula as follows:

$$I.\ H.\ P.\ varies\ as\ P.\ R.\ D.^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (2);$$

or, since with a given average value of slip the product $P.\ R.$ varies as the speed, we may express the formula thus:

$$I.\ H.\ P.\ varies\ as\ speed \times D^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (3).$$

This form in particular shows that the formula is entirely unsuited to propeller design, or to the expression of any rational relation between the various quantities involved. It is well known that the power for ship propulsion varies closely as the cube of the speed rather than as the first power, so that as an expression for the relation betwen the power and the product $P.\ R.$, such a formula would be entirely useless and misleading.

As a matter of fact the formula in (2) above should read:

$$I.\ H.\ P.\ varies\ as\ P^3\ R^3\ D^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (4).$$

or, to express the relation with P on the left-hand side of the statement:

$$P\ varies\ as\ \sqrt[3]{\frac{I.\ H.\ P.}{R^3\ D^2}}.$$

A complete discussion of this formula would open up the entire problem of propeller design, and would require more space than is here available, but the simple and well-known relation of power to the cube of the speed will serve at least to show the error of a formula in which power is related directly to the speed instead of the cube of the speed as experience demands.

Q. 242.—Kindly publish formula for finding helicoidal area of propeller, in your September issue. P. J. R.

A.—Understanding your question to concern the area of a propeller blade already built, the method suggested is to draw on the blade in chalk a straight center line from tip to hub about equidistant from the edges. On this line lay off a number of equidistant points and at each one draw a line square to the centre line. Measure up each one of these perpendicular lines from edge to edge, add them all together, divide by the number of such lines and multify by the space between two adjoining lines, the product will be the approximate area of the blade. This area times number of blades gives area of propeller, so termed.

Q. 243.—Will you please give me your advice on the following details in your next issue, if possible? I have a three-cycle compound engine, fore and aft, with cylinders 4, 5 3-4, and 5 3-4 inches by 5 inches stroke, and steel shaft 1 3-4 inches diameter, cranks at angles of 120 degrees. I wish to build a boat for this engine, so that she will steam not less than 10 knots per hour. The engine is good for 200 pounds of steam per square inch. What length over all, length of keel, width of beam, and draft of water would you advise me to build? Also what size propeller, together with pitch and number of blades, would be best, and what amount of cooling or tube surface would be required for a surface condenser for the above-size engine? The weight of machinery in proposed boat, including other things, will be from 2 to 3 tons. Air, feed, and circulating pump are indepenedent.

Would you also be kind enough to inform me how kerosene oil compares with coal, both as regards efficiency and cost for a given amount of power, and the best method for using the same for fuel. Your answere in a previous number concerning cut-off on low-pressure valve of compound engine figures out correctly from indicator cards taken; many thanks for your valuable information. L. W.

A.—To answer your question we must reverse the usual operation, for instead of designing an engine to suit the boat you wish to design a boat to suit the engine. We will proceed to ascertain the horse power

of your engine in the usual method as indicated in several previous queries.

In the absence of data we must make certain assumptions. First, we will consider that the 200-pound boiler pressure means gauge pressure and that you will have a boiler of ample size to furnish all the steam required. Next we will assume that the engine is to run at 400 revolutions and that the cut-off in the high-pressure cylinder is to be two-thirds of the stroke. Finally, we will assume that there will be a drop of 15 pounds from the boiler pressure to the engine throttle and that the pressure at the latter point will be $215 - 15 = 200$ pounds absolute. The back pressure resulting from condenser we assume to be 6 pounds absolute. We are now ready to proceed with the power calculation, and the first quantity to ascertain is the mean effective pressure, p_m referred to the low-pressure cylinders.

Let r = ratio of expansion.
p_1 = initial pressure absolute.

$$\text{Then } p_m = p_1 \frac{1 + \text{hyp. log. } r}{r} \quad \ldots\ldots\ldots (1)$$

In order to find the value of r we divide the volume of the sum of the low-pressure cylinders by the volume of the high-pressure cylinder up to the point of cut-off. Thus,

$$r = \frac{26 \times 5 \times 2}{12.6 \times 5 \times 2\text{-}3} = 6.3.$$

The fractional expression at the right hand of (1) must be worked out from the table of hyerbolic logarithms, or from a handbook* the value of the entire expression will be found in tabular form for this value of r to be $= .44$. Therefore,

$$p_m = 200 \times .44 = 88 \text{ pounds.}$$

From this should be subtracted 6 pounds back pressure, leaving 82 pounds. Now, in order to allow for clearances, radiation, compression and drop of pressure, etc., this value should be multiplied by a "card factor," which, for this special case, we judge to be about .6. Thus the mean effective pressure is 49.2.

We now follow the well-known formula for horsepower, namely:

$$I.H.P. = \frac{P.L.A.N.}{33{,}000} = 26 \quad \ldots\ldots\ldots (2)$$

From the comparison of many performances of all types of boats there has been evolved an empirical formula concerning the relation of displacement, horsepower and speed. This gives what is called an admiralty coefficient. The formula is as follows:

$$I.H.P. = \frac{D^{2/3} \times S^3}{C} \quad \ldots\ldots\ldots (3)$$

where D is the displacement and S the speed in knots. C is a constant, which for this particular case we will take as probably 200. From this formula the displacement on your proposed vessel may be obtained by transferring the terms as follows:

$$D^{2/3} = \frac{I.H.P. \times C}{S^3} = \frac{26 \times 200}{1{,}000} = 5.2 \quad \ldots\ldots (4)$$

*See Seaton and Roundthwaite's Pocketbook of Marine Engineering, page 42.

This last figure is the square of the cube root of your displacement. Therefore, the displacement = 12 tons.

The problem now is to ascertain the dimensions of length, breadth and draft for a boat of 12 tons displacement. This will be of necessity a cut and try procedure. In the first place, let us assume that the block coefficient (actual displacement in cubic feet divided by the product, length, breadth, draft) $= .55$. Then the result of multiplying the three dimensions of the final boat must be 770 cubic feet.*

In a boat about the size which you propose to build, the beam should be about four times the draft and the length about five times the beam. Let us assume a draft of 2.1 feet and see how this will suit.

$$2.1 \times (4)\ 2.1 \times (20)\ 2.1 = 740 \text{ cubic feet.}$$

As this comes very close to the limiting displacement, 770 cubic feet, you can safely use these dimensions for your boat, varying same as in your judgment is necessary for the special design. The dimensions are:

Draft of hull, not including keel.....	2.1 feet.
Beam at water line.....	8.4 "
Length on water line.....	42 "

The propeller formula is as follows:

$$pN = 117\,u \quad \ldots\ldots\ldots (5)$$

Where p = pitch
N = number of revolutions per minute
u = speed in knots.

We already have found the number of revolutions and the speed. Solving this formula, we have

$$p = 117 \times \frac{10}{400} = 2.92 \text{ feet,}$$

for the pitch of the propeller. A suitable ratio of pitch to diameter would be about 1.2. Therefore, the diameter of the wheel would be 2.43 feet. This calculation is for a four-blade wheel. For a three-blade wheel the diameter should be increased two or three inches. This also assumes that the actual area of the four blades will be about 35 to 40 per cent. of the total area of a circle the same diameter as the wheel.

In answer to your question concerning the relative efficiency of coal and kerosene we do not understand whether you refer to coal being used in a boiler and kerosene in an explosive engine, or whether you propose to burn the kerosene for generating steam. The heating value of one pound of coal is about 13,000 British Thermal Units, while the heating value of one pound of kerosene is about 23,000 B.T.U. The cost of fuel in 24 hours per horse power in a kerosene explosive engine, with kerosene at 12 cents per gallon, and using 1-8 gallon of kerosene per horse-power hour is about 36 cents, while the fuel cost per horse power for twenty-four hours in a steam engine with coal, at $3 per short ton, is about 9 cents. For types of kerosene engines we refer you to Mr. H. B. Maxwell's article in the August Marine Engineering.

Q. 244.—Please answer through your magazine the following questions: What is meant by cutting off 10 or 12 inches, as the case may be? What is the advantage in a cut-off on intermediate-pressure or low-pressure cylinder? E. L.

*12 tons $\times$ 35 = 420 cubic feet, 420 $\div$ .55 = 770 nearly.

A.—By cut-off is meant that point in the travel of a valve at which the supply of vapor is cut-off from the working cylinder. This point is spoken of in two ways, either in the per cent. of stroke of the piston of the engine to which the valve is attached, or in the number of inches which said piston has traveled when this point of cut-off is reached. For example, in an engine with a stroke of 30 inches, a cut-off of 50 per cent. means that the valve closed when the piston has traveled 15 inches of its stroke.

It is necessary to have a cut-off on the intermediate and low-pressure cylinders of a triple expansion engine for several reasons. In the first place, if the steam is not cut-off at the end of the stroke when the exhaust port is opened, steam from the first receiver would blow directly through into the second receiver, and similarly the low-pressure exhaust which would blow through to the condenser without performing work. Thus the back pressure on the high-pressure cylinder would be practically the same as the condenser pressure. From this it follows that the point of cut-off on the intermediate cylinder will regulate the back pressure on the high. Thus with an early cut-off on the intermediate, the first receiver pressure will be high, while with the low cut-off it will be low. The same remarks hold true of the cut-off on the low. It is by varying these two cut-offs that the distribution of power between the three cylinders may be adjusted.

Q. 245.—Can you give the formula to get the horse power required to drive a propeller of any size at a certain speed?

S. M. W.

A.—As a propeller wheel problem is attacked from the other side; that is, the wheel is designed to suit the requirements of power, speed, and revolutions, it is impossible to fully answer your question in the limited space of this column, and we recommend you to obtain some of the standard text books concerning this all-important feature of propeller design.

The general method of procedure is to first calculate the amount of power required to drive the vessel at a certain speed, and then to design a suitable propeller. We refer you to Q. 243.

Q. 246.—I have conceived an idea that a small quantity of kerosene poured into the tank of a gasoline launch would be a benefit. Would it not prevent internal corrosion of the tank and pipes, and also serve as a lubricant to a limited extent? Would it not also lessen troubles incident to the ignition problem? Kindly take 10 gallons of gasoline as a basis and figure out how much kerosene I could safely use.

In your opinion do you think a series of carefully-conducted experiments along this line would prove of interest and value, or has this been done already? M. W. I.

A.—From the information at hand we do not see why the mixture of kerosene and gasoline would result in any noteworthy economy. Nor do we believe that it would "lessen troubles incident to the ignition problem." Gasoline is much more volatile than kerosene, and, therefore, it is easier to vaporize into an explosive mixture. The calorific value of gasoline is between 18,000 and 20,000 B. T. U. and that of kerosene from 22,000 to 24,000 B.T.U. Kerosene engines are now being placed on the market, using, as the name implies, kerosene for fuel. We would refer you to Mr. H. B. Maxwell's article on Oil Engines in the August MARINE ENGINEERING.

Q. 247.—Referring to Attwood's Text Book on Theoretical Naval Architecture, page 120, will you kindly explain, through THE MARINE ENGINEERING, the figure 12 in the following example:

$$G\,M = \frac{25 \times 36 \times 15 \times 12}{10.312 \times 5,372} = 2.92 \text{ ft.}$$

A.—This formula being expressed in foot tons, all dimensions must be given in these measures. You will notice that the mean deviation is 10.312 inches, and to reduce this into feet divide by 12. As 10.312 is in the denominator, 12 is placed in the numerator. The formula might also be expressed as follows:

$$GM = \frac{25 \times 36 \times 15}{\frac{10.312}{12} \times 5372} = 2.92 \text{ ft.}$$

Harmsworth Motor-Boat Cup.

The reliability trials arranged by the Automobile Club of Great Britain and Ireland and run in Southampton water the last of July, proved that the gasoline motor is really reliable for continuous work afloat. The club being fully convinced that the oil motor, if it were better known, would be largely taken up by ship owners and others who at present use a great number of small steam launches, decided to institute a series of reliability trials for several classes of motor boats. Sixteen boats were entered in the competition, which was over a course of 19 1-2 nautical miles. All the boats with two exceptions completed the stipulated ten hours' run on the first day. On the second day the entire sixteen boats steamed over the same course for ten hours.

A few days later the races for the International cup, the Harmsworth trophy, were run in the Solent, and resulted in a victory for the *Napier Minor* owned by Mr. Edge. The first race in the heats was between three boats of the three nationalities represented, the American *Challenger,* 40 feet by 150 horse power; the British *Napier II.,* 40 feet by 120 horse power; and the French *Bayard,* 40 feet by 180 horse power. The French boat did not start as her propeller fouled the mooring chain. The American boat was in the lead at first, but she was overhauled and badly defeated by the *Napier II.* The second heat was between the *Napier II.* and *Napier Minor,* in which the first boat won by twenty seconds. The final race thus should have been *Napier II.* and *Tréfle-à-quatre,* but the English boat was by this time making water so fast that *Napier Minor* was put in her place. The final was postponed some time, till the King arrived in the royal yacht, about 4 o'clock, by which time it was raining heavily. The British boat made the better start of the two, improved her lead throughout the race, and crossed the line 84 seconds ahead of the *Tréfle-à-quatre.* The course was 7.7 nautical miles long, and the *Napier Minor* covered it in 23 minutes 3 seconds, or at a speed of about 20 knots.—*Shipping World.*

Quintard Iron Works.—The Quintard Iron Works Company was recently incorporated under the State of New York to operate the works at the foot of East Eleventh and Twelfth streets, New York, N. Y. The officers are: President, Nicholas F. Palmer; Vice-President, Stevenson Taylor; Treasurer and Manager, George Quintard Palmer; Secretary and Assistant Treasurer, James M. Wellman.

A Steamship Vision of 2,000 A. D.

BY E. N. PERCY.

Wet through with water from a hot pin and tired out, I crawled up from the lower platform to come off watch. I was an oiler on a freighter running from New York to Z——, and in a hurry for promotion. It was in the year 1905. As I pulled off the grimy clothes, set the filthy shoes in one corner, and went to the cold-shower room to clean up, going to sea appealed to me as the worst possible way of making a living. A little later, as I lay between the blankets and dozed off, I felt it was not so bad after all.

. . . . . .

Nearly sixty years have passed since that night, and as the aged superintendent-engineer of the Royal Express line of fast passenger boats, I look back to the primitive steamers of the early part of this century, and wonder how men endured what they did in seagoing craft. This boat, which we are now traveling on, is more than a thousand feet long and it is the fastest boat in the world. See how clean and quiet everything is! No noise, no vibration, no dirt, no oilers, no stokers, no ashes. How do we do it? Come below and see; do not trouble to help me; I am as spry as when a young man of sixty. These elevators are much handier than the ladders of thirty years ago. Just take us down to the fire room, elevator man.

Did you ask where the firemen are? Bless me! steamships have not carried firemen for twenty-five years. The senior engineer on watch alone operates the fires and boilers. "Boiler" is nowadays an obsolete term; you should say "generator." You see through this colored glass the fire. The generator is a steel forging full of channels and passages, from which steel tubes rolled flat and thin radiate. This is all kept at a high temperature by the fire, yet no steam is in it; it is kept full of water at all times by the pump, and constantly absorbs the heat of the fire. That big valve up there marked like the combination of a safe lock is the flash valve; there the water escapes, flashes into highly superheated steam, and goes to the engines at 500-pounds pressure. The pressure in the generator is constant at 800 pounds. The feed pump stops when the generator is solid full, and then only.

The bunkers are hermetically sealed and the coal is carrid as dry powder, finer than flour. It is drawn out by blowers and burns in the furnaces with an intense, almost invisible, bluish-white flame. There is no ash, no clinker, no smoke. No firemen are necessary, and their quarters are done away with. No water tenders are needed, for when the pump cannot put any more water in the generator it stops. The ship is coaled by blowers in one or two hours and the bunkers are seldom opened for any purpose whatever, as since they have done away with rivets, ships don't leak. You know ships nowadays are all welded by electricity, no rivets used whatever. To-day we are using the blowers, because it is so smooth. You see they run by electricity. It took engineers a good part of the early portion of this century to learn to quit using high-speed steam engines on blowers. Those were the days of reciprocating engines, too. In heavy weather we shut these blowers down and use the caisson. It is a contrivance that utilizes the plunging of the ship to compress air for running the burners. It works well and saves us much coal on a rough trip.

Let us go into the engine room. Where is the engineer? Dear, dear, what old-fashioned ideas you have. You see here three large steam turbines very much like the first ones tried in 1890 and 1900. Each runs a separate propeller. The two outer ones are reversable. They are controlled by electricity direct from the bridge and run for our three days' trip across the Atlantic without anyone so much as looking at them. There is no attendant here at all, except that apprentice you see over there by the dynamo. You will note that each turbine has a dynamo, direct connected, that will run in either direction. All auxiliary machinery on the ship is electrical, and takes its power from these dynamos. Over there is a small independent dynamo for use when necessary in port. The ship is lighted from the main dynamo; their speed is absolutely uniform, as the turbines are perfectly governed, although they run at 800 revolutions and have fine pitch propellers. Another advantage of the electric system is that in port it is not necessary to keep pressure up in the generators, as the ship takes current from the dock for lighting, pumping bilges, hoisting freight, etc. Also, the main dynamos are used as motors, for slowly turning over main engines. That middle turbine, which stands about 10 feet high, and about 40 feet long, develops 40,000 horse power.

Did you ask for the circulating pump? Another one of your historical jokes! Did you suppose we threw away our heat as they used to in 1904 to 1920, and even before that? Here is a reservoir of anhydrous ammonia. This chemical at atmospheric pressure boils at 26 degrees Fahrenheit. At the temperature of the inside of the main condenser here the ammonia is raised to a pressure of 308 pounds at present. The ammonia is introduced here instead of circulating water, and the heat of the condenser raises it to the above pressure. From here it goes to that little turbine on the front of the center main turbine where it helps develop power, the same as steam. From there it goes to the compressor. You do not see the compressor? Why, there it is; you surely don't have in mind those old reciprocating ideas again? The compressor is driven by a turbine running at 20,000 revolutions. The compressor itself is much like a turbine. It consists merely of spiral vanes on the same shaft, which are split up into sections like the old Parson's turbine. These are large in diameter where the gas enters and small where it leaves, giving the machine the appearance of a top or cone. Incidentally, the machine has no bearings, and sucks and discharges through flexible metal piping. It spins on its pedestal like a top, and the pressure of the steam takes much of the weight off of that even. You see how small it is, yet it is a 1,000-horse-power machine. Electricity is not yet adapted to these tremedous speeds, for all of its boasts. Steam is the fastest actual mover we have. A fly wheel made of any material in any manner can be run to its bursting point by the direct velocity of a jet of steam properly applied.

This is the ammonia condenser. You will note that it is cooled by air from that blower, and a very clean process it is, I assure you. The air thus warmed is used for forced draft in conjunction with fuel blowers. Yes, the feed water is very cold, as we get the full bene-

fit of 28 1-2 inches of vacuum. Our feed water goes to that honeycomb affair in the smokestack, and commonly attains a temperature of 200 degrees Fahrenheit before going into generator.

How do we keep condenser tubes tight to keep ammonia and steam separate? We set the heads at a slight angle to each other and curve the tubes so they can sag for expansion, and then bead over the ends and drive in a heavy taper ferrule. We use steel condensers and tubes as ammonia would corrode composition tubes. How do we clean them? Why, they never get dirty. You are probably thinking of the times when oil was used in engines. Turbines require no oil internally. Steam drawn here anywhere will condense into the purest of drinking water.

From the ammonia reservoir you see a pipe covered with frost. That pipe goes to the steward's department and does all the refrigerating for the ship, keeping store rooms below freezing, and operating the big 50-gallon freezers for desserts, ices, punches, etc. Here you see the return from the refrigerating plant where it enters the main compressor suction.

You ask what those long, slender cylinders are that are connected to the electric motors? These are the pumps. They are nothing more or less than a modification of small propellers and centrifugal pumps combined. They run at 6,000 revolutions, which is about the limit for electric motors. These others are bilge, fresh water, or miscellaneous pumps. All of the rotary type, you will notice. It takes a man of unquestioned ability to design modern rotary machinery. Scant attention was paid to its great importance in the early part of this century. They all stuck to the reciprocating type, because few men clearly understood the resultant combinations of these intricate forces or the necessity of doing away with packed joints. Pumping, gas compressing, power generation, etc., should be reduced so far as possible to rotative motion. See what the great printing press became when the designs for rotating machines took the place of reciprocating machinery.

We use a combined roller and ball bearing in all our bearings that requires no lubrication whatsoever. We have the same in the outboard bearing, but on arriving in port this bearing is pumped full of tallow to exclude the water.

The ship is warmed and ventilated by a system of high-pressure blowers or air compressors, which draw warmed air from around the smokestack and force it through small pipes into the rooms.

That man on the platform is the junior engineer. He is not yet trusted to operate the generators and burners, but has served his time as apprentice attendant in engine room where there is little responsibility except to watch for something to go wrong, which seldom happens.

In the glass cage opposite the engineer are all the steam gauges, a dial showing the speed of the ship, a camera obscura showing scenery all around the ship, a telephone with the modern automatic central switch connecting instantly to any part of the ship, an electric pyrometer for indicating the heat of every fire, and indicators to show the direction of rotation of all the main engines. Other indicators inform him of the movement of every machine on board. He receives the orders for steam and for preparation and transmits them to his superior. A few mechanics are carried for emergency, also a few laborers to keep things clean. After a man has served as junior on third, second, and first watches, he may be promoted to senior, and serve successively on third, second, and first watches. Next he is promoted to deck engineer and handles the controlling apparatus for the commanding officer. Here he learns navigation, becomes quartermaster, officer, and some day captain. Engineers and quartermasters receive about the same pay, and their duties are much the same, as they must be skilled mechanics. Officers and captains are able men and amply compensated. The next highest position is assistant on shore to the superintending engineer, who is, next to the company's fleet captain, a position that is well nigh equal to the presidency in importance.

. . . . . .

At this moment a terrific report rent the air, the wonderful ship gave a lurch, and blackness settled down over me. I opened my eyes and looked around. Bill, the other oiler, was shaking me, saying it was time to come on watch. I was still on the old packet, a boy oiler, in the "early part of the century." I put on my clothes, which were now dry, and was soon "slinging fat" again on the groaning, pounding, reciprocating engine.

Notes About the Victoria Dock, London.

Editor Marine Engineering:

Herewith I send you a few sketches of some new devices which I have seen on vessels around these docks. I pass two dry-docks nearly every day and therefore see many different ships.

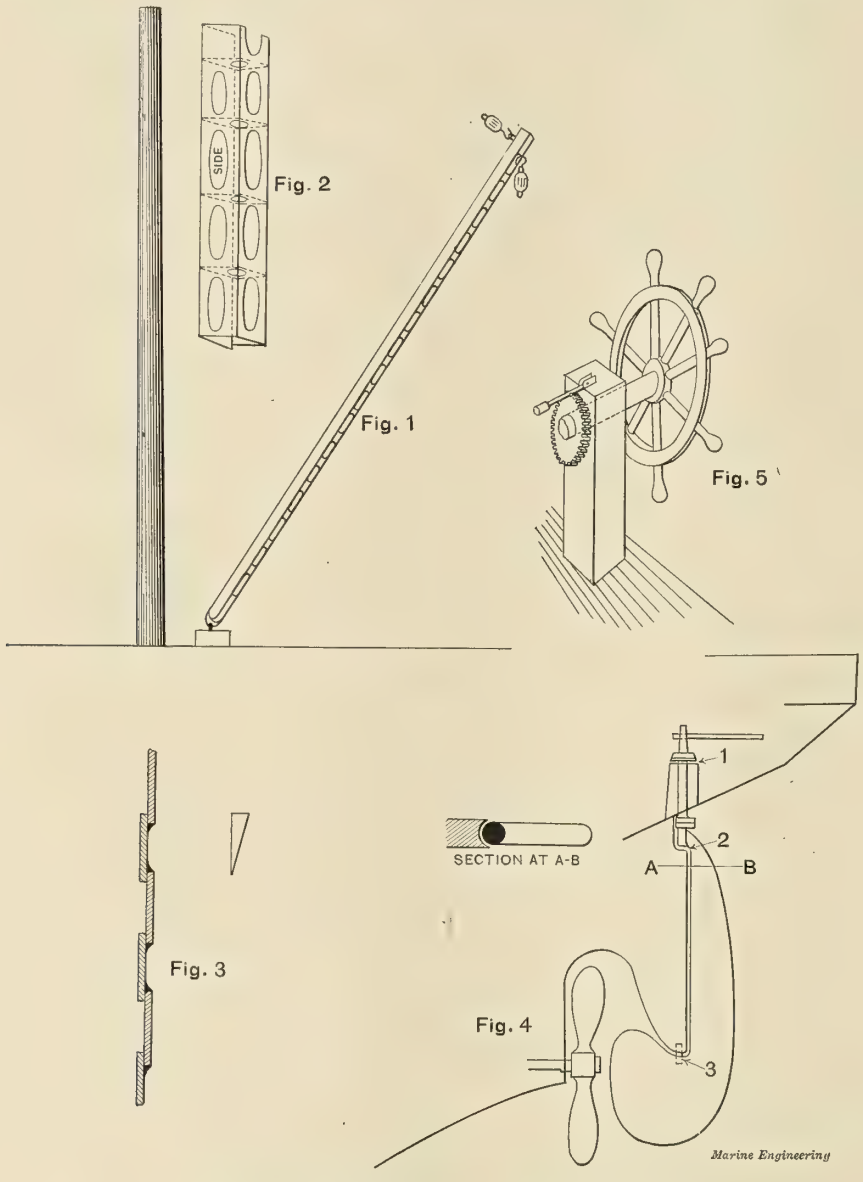
In Fig. 1, I have sketched a new style of heavy derrick used on the new S. S. *Ayrshire*. It is built on the plan of a bridge girder, of 5-8-inch plate on the side and 1-2-inch plates top and bottom, with lightening holes as shown. The girder is 14 inches square and between each lightening hole is a square bracket brace inside. The derrick is claimed to be lighter that the usual style of derrick of the same size and lifting capacity. Fig. 2 shows an enlarged section of this derrick.

The S. S. *Sussex*, of the Federal line, and one other new ship I noticed, are fitted with wedge-shaped cargo battens on the side plating, to prevent cargo from catching on the corners of the plates. It is a common experience when discharging or receiving cargo from lighters along side, that package freight, such as dry goods, will often swing and catch on the edge of the plate, resulting in damage unless care is observed. More than once I have seen a sling board capsized when working hurriedly. The batten shown in Fig. 3 consists of a three-cornered strip of iron three or four inches wide of the thickness of plate and tapered to a joint. These strips are fitted on the outboard sides of plating above and below the laps. This is a very simple idea and I wonder it has not been oftener adopted.

The only type of stern out of the ordinary that I have seen is the one shown in Fig. 4. This sketch is taken from the S. S. *Machaon*, of Liverpool, 7,000-tons register. The dead wood is cut way aft and the stern

post and rudder are strongly built. The weight of the rudder is divided between the main bearing (1), the gudgeon (2), and on a special ball and socket joint (3). It is claimed that the ship answers the helm quicker than with the usual rudder. It strikes me that with such a device there is less kicking to the rudder. The after end of stern post is grooved to fit the rudder post.

while the latter was engaged in cleaning brass work, making a sinnet, or patching the mate's shirt. On the shaft just abaft the support is a small square-toothed wheel, while on the support of the shaft is a locking handle, made to fit between the teeth of the wheel and hinged on the support. This device will hold a steering wheel in any position, but in my opinion an iron ball



SKETCHES MADE OF NEW DEVICES ABOUT THE VICTORIA DOCK.

Figs. 1 and 2, Cargo Crane.
Fig. 3, Cargo Batten
Fig. 4, Balanced Cast Steel Rudder.
Fig. 5, Steering Wheel Lock.

A lock for securing steering wheel, which has recently come into use here on new sailing barges, is shown in Fig. 5. This device is handy for small craft where the helmsman is sometimes obliged to leave the wheel, and it is a decided improvement over a rudder lashing or becket to slip over the spoke of the wheel. Often in my sailing-ship days have I seen "Blind Jack" at the wheel in place of the man who was supposed to be at the wheel, placed on the end of the handle would improve it, as it would prevent any "kicking" of the rudder from knocking the handle out of place.

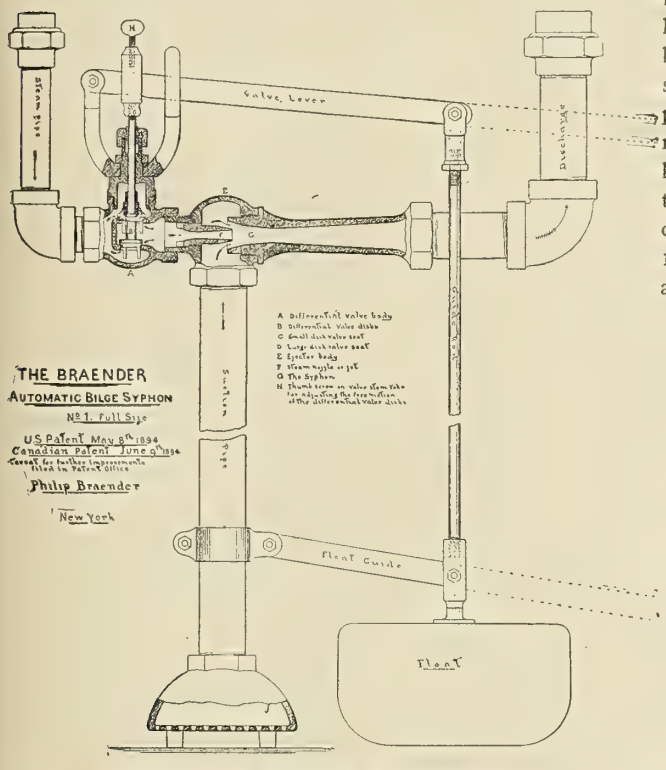
I visit several ship yards over here, but in none have I seen such up-to-date machinery as is installed in some of the plants at home. Wages are lower here, but in my opinion an American shipwright does more work.

C. O. TILTON.

ENGINEERING SPECIALTIES.

An Automatic Bilge Syphon.

The Braender syphon is a simple and inexpensive device, put upon the market by Philip Braender, of 63 West 125th street, New York, N. Y., for automically removing bilge water from the hold of steam and sailing vessels. It has been endorsed by leading marine engineers and it is claimed will remove large quantities of water at a nominal cost for operation; either water or steam pressure being employed. An important claim is that there is practically no possibility of its parts becoming disarranged.

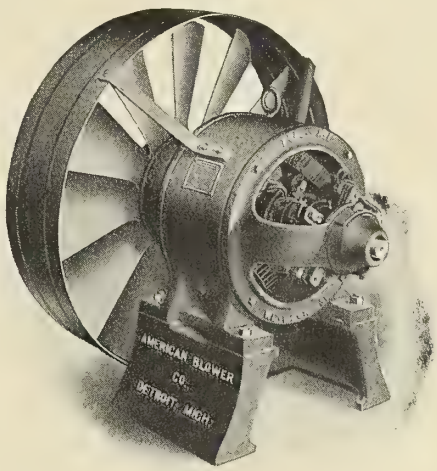


MECHANISM OF AUTOMATIC BILGE SYPHON VALVE.

The sectional view shows the mechanism of the differential double-seated valve. This valve is made of brass with metal seats and ground joints. It requires no leather or other packing, as the water to be removed does not pass through the valve, which is only to regulate the supply of water pressure. It is thus not exposed to injury or liable to stick or clog.

The valve, as is shown, is operated by a brass lever and copper float, and opens and shuts automatically. The float rises when sufficient bilge water has accumulated in the vessel to call for the services of the syphon and in doing so brings a tension through the lever and its connections, upon the valve which opens suddenly, admitting the water under pressure through the supply pipe. The water being discharged through a small opening, causes a vacuum or suction and raises the accumulated water to the nozzle and carries it along through the discharge pipe, and thus continuing until all the water accumulated is removed.

The action of the differential valve is the secret of the successful working of the device and is as follows: the area of the upper disk being about twice that of the lower disk, the pressure due to this difference in size holds the valve shut until the bilge water has gained such a head as to raise the float, which in turn lifts the upper disk from its seat, and starts the ejector instantly, at its full capacity. As the water is discharged the float descends to nearly its lowest position, bringing the differential disks of the valve to a position from which the steam or water pressure suddenly shuts the valve and the syphon ceases until sufficient water is again accumulated. The amount of free movement of the differential valve is regulated by the space in the valve stem yoke in which the lever has full play. This space is in turn regulated by the thumbscrew *H*, in valve stem. As this thumbscrew is not connected with the lever the rolling and pitching of the ship in which this syphon is used does not in the least affect it, until the requisite height has been reached by the bilge water accumulating in the hold. This syphon is made in three sizes, with a capacity per hour, at 50 pounds steam pressure, of from 1,500 to 3,000 gallons, and may be seen in operation at the manufacturer's address.



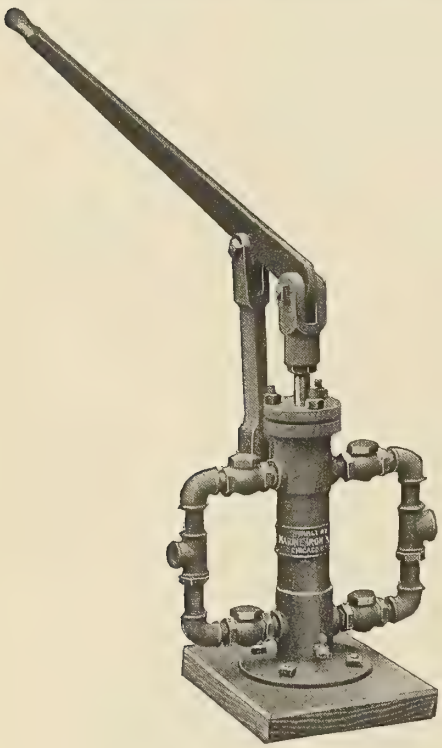
NEW STYLE OF DIRECT-CONNECTED VENTILATING FAN.

Direct-Connected Fan and Motor.

The progress made in the line of direct-connected disk fans and motors is shown in the accompanying illustration, which is of the American Blower Company's disk fan and the Westinghouse motor. It will be seen that instead of the motor being attached to the frames of the fan, as has heretofore been customary, it is placed upon a substantial base, there being no bearings except those to the motor. Each set is carefully tested and inspected before leaving the factory. The high efficiency claimed for both the "A B C" fan and the motor, together with the fact that the prices charged are low, make these outfits unusually desirable for cooling and ventilating. The home office and works of the American Blower Company is Detroit, Mich.

A Reliable Test Pump.

A small test pump, valuable on shipboard for testing pipes, valves, gauges, and boilers, is made by the Marine Iron Works, Station A, Chicago, Ill. The pump has a semi-steel cylinder, brass piston, and piston rod, and forged connections. It is a double-acting pump with double check valves; the suction is for a 1-inch pipe and the discharge for a 3-4 inch pipe. One man can work the pump against 500 pounds hydrostatic pressure. In the illustration the pump is shown fastened to a baseboard, but a different form of base is made when desired. Repacking or cleaning is conveniently done by simply unbolting the head of cylinder and lifting the piston out. The weight, including base plate, is 60 pounds.

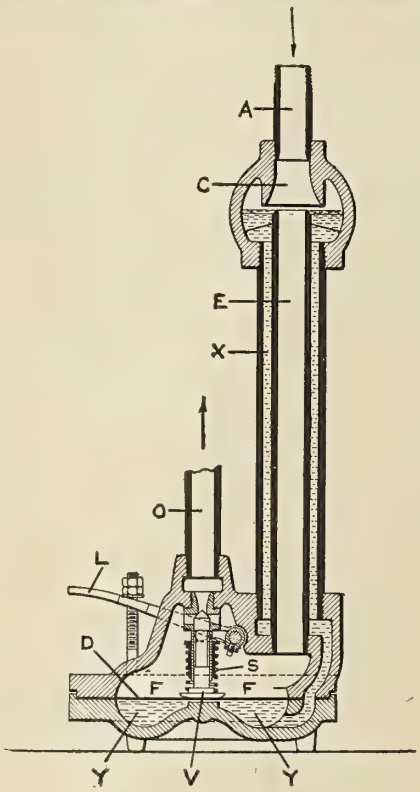


A PORTABLE HANDY TEST PUMP.

A New Steam Trap.

A steam trap, specially adapted for marine use, as its action is not affected by inclination of the ship, is made by Richard J. Flinn, West Roxbury, Mass., and is here illustrated. The trap works every time the water rises above the water seal line and every time it falls below it, and as there is the same steam pressure on both sides of the diaphragm, the trap will work under any pressure.

Referring to the illustration, the operation of the trap is due to the column of water *X* acting upon the diaphragm *D*, which closes the valve. Thus, the water of condensation enters at *A*, fills lower chamber *Y*, pipe *X* and receiving chamber *C* up to the level of the top of pipe *E*. This column of water, acting on the under side of the diaphragm *D*, forces the valve to its seat against the counter pressure of the spring *S*. Any additional water that enters the trap overflows through pipe *E*, filling chamber *F* and pipe *E* to a point about midway of its height, where the effect of the column of water in pipe *X* is balanced. The pressure on each side of the diaphragm is then equal—the shorter column in pipe *E*, aided by the spring, balancing the pressure of the longer column in pipe *X*. Any further increase in the height of the water in pipe *E* causes a depression of the valve *V*, which allows water to escape until the column has fallen to a level a little below the middle of pipe *E* when this valve closes again. This action is repeated at intervals according to the quantity of water entering the trap. So long as the water keeps coming in sufficiently large quantities the valve remains wide open.



SECTION OF A FLINN TRAP.

The shell of the trap is of close-grained cast iron, well designed. The valves are of hard bronze, the diaphragm is of phosphor bronze and the springs of steel.

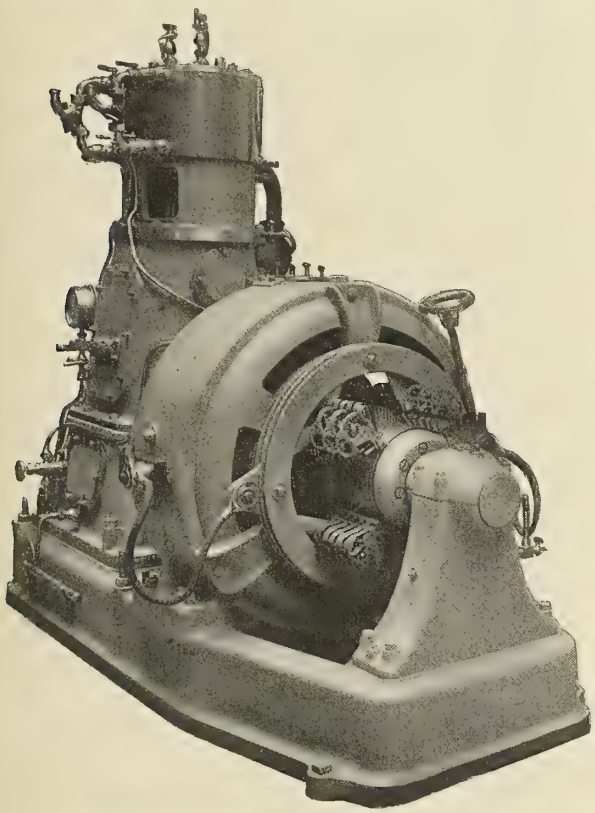
There are but three working or moving parts, the spring, the diaphragm, and the valve itself. The adjustment of the spring is accomplished by the outside lever *L*, which lever also serves to open the valve for blowing out the trap. This is sometimes necessary when grit and dirt pass into the trap from the steam pipes and get under the valve. By depressing the outside lever *L*, the valve *V* is thrown wide open and the trap can be blown out.

Engine for Direct-Connected Set.

The Thornycroft enclosed engine is of the double-acting, two-cylinder compound type, with forced lubrication. The high-pressure and low-pressure pistons

drive the cranks, set at 180 degrees, of a shaft without a center bearing. This omission reduces friction and gives room for a shaft bent from a bar with easy corners and long crank pins, all surface of metal being well hammered.

The separate high-pressure and low-pressure piston valves are driven from opposite ends of a lever rocking between the guides and actuated directly from the high-pressure big-end. Their great lap minimizes leakage, while their inertia, balanced as regards foundations, greatly improves the turning moment. The high-pressure cylinder and valve chest is separate from the low-pressure, but connected by a breeches receiver. These, together with a throttle and stop valves, are surrounded by a cylindrical lagging case, on removing the covers of which all covers are exposed. Steam economy is promoted by the flat cylinder ends and ports, by the deep



THORNYCROFT ENGINE-DRIVEN ELECTRIC GENERATOR.

pistons, and by the separator action of the receiver. Close speed regulation is promoted by the small volume of the high-pressure and low-pressure steam chests, and by the ease with which the low-pressure steam can be throttled. The high-pressure cut-off can be made late for overloads without alteration of the valve gear. Ample water relief is provided by three relief valves in each end of each cylinder. Instead of mounting the crank chamber and dynamo on an under bed, the dynamo bed is bolted to the end of the deep crank chamber. This arrangement gives a good connection under the ring of a multipolar dynamo without side wings, and utilizes the full depth of the crank chamber as an oil-settling tank.

This engine is made by John I. Thornycroft and Company, Ltd., Chiswick, London.

TECHNICAL PUBLICATIONS.

Practical Shipbuilding; A Treatise on the Structural Design and Building of Modern Steel Vessels. By A. Campbell Holms. Two volumes, text, and plates. Size of text 5 by 9 inches, pp. 627. Size of plates, 13 by 26 inches, pp. 115. Longmans, Green & Company, London and New York. Price, $16.00.

This book forms a notable addition to the literature of the field of marine construction, a field which in English has received but slight attention from those best qualified to add to its scanty pages.

The general purpose of the author has been to deal in a comprehensive way with all important practical questions and operations of modern ship building, as an aid to those who may desire to acquaint themselves with the details of this field of modern industry.

The work as a whole is divided into forty-one chapters dealing with convenient subdivisions of the general subject matter. In accordance with the general plan of the work, attention is first given to the fundamental matters which govern the design of the ship considered as a structure. This requires detailed consideration of the various stresses to which the hull is exposed, their effects on the structure, and the different forms of design by which the necessary strength may be secured. This broader view then naturally leads to a more individualized consideration of each important member of the hull, and from three points of view: (1) Its purpose in the structure and the particular stresses and straining effects to which it is liable. (2) The various formations available in its design, with the rules governing them as regards scantling and strength. (3) A description of the actual work of making it in the shipyard, and erecting in place in the ship.

Due to the status of Lloyd's rules as a standard for British shipbuilding they are naturally referred to frequently throughout the work, and are taken in general as the standard of constructive practice, both in text and plates, though occasional reference is made to variations represented by the rules of the British Corporation and Bureau Veritas where of especial importance.

In addition to the topics dealing directly with ship construction, a number of related subjects are carefully considered as well. Thus we find chapters on the manufacture and mechanical qualities of steel for shipbuilding purposes, on corrosion, fouling and anti-fouling paints, on preparation of ship ways and launching, on ship equipment, etc. In short, the obvious purpose of the author has been the detailed treatment of every subject having to do with ship design and construction, from the earliest start in the drawing office to the delivery to the owner, propulsive machinery alone excepted.

This programme as a whole is divided into two main parts. In the first, comprising the first 31 chapters, the author deals with the various principles involved, and with the various members and modes of ship construction from the descriptive standpoint. That is, the various members of a ship and various modes of construction are described as they are, and without reference to the constructive operations which they may involve. In part II., comprising chapters XXXII. to XLI., the author deals with constructive operations, and discusses the various shipyard processes suitable for the production of the forms of construction considered in part I.

This general plan is admirably adapted to a detailed and orderly consideration of the vast multitude of topics in hand, and under the author's treatment it has produced a most comprehensive and valuable work for the student of this branch of engineering construction. The author's style is clear and his presentation of the subject shows an intimate acquaintance with shipbuilding, both from the designing and the constructive points of view. It is not to be assumed that any book or any amount of book study can alone make a shipbuilder, or give to the student of the art a thorough practical acquaintance with his subject. To this end, actual contact with the work in a drawing office and shipyard is needful. For such a comprehensive and carefully-considered work as the present, however, there is a very distinct and large field of usefulness. Its careful study by the student of the subject will serve to give him rational and accurate ideas regarding the basis of ship design and construction, and will enable him to better understand the practical operations which may pass under his observation. It will serve to enormously shorten the time in which he can acquire a reasonably adequate acquaintance with his subject, and will give him such broad and comprehensive views as will most rapidly fit him for wider and more responsible duties in connection with his work.

Such a comprehensive and thorough work as the present constitutes also a valuable record of progress in the art of shipbuilding, and as such has a distinct value aside from its primary purpose as an aid to the student of the subject.

In the author's concept of his subject he has avoided all forms of theoretical discussion or treatment involving higher mathematics and mechanics as an aid, though of necessity the results of such investigation are freely used and referred to as established facts. This has the advantage of rendering the work freely open to all readers, whether acquainted with higher mathematics or not, while on the other hand much of the rational part of the treatment, including the discussion of general principles, must be either taken for granted, or sought for elsewhere in works dealing with these phases of the subject.

In order to hold, however, the general discussion of so wide a subject within reasonable bounds of space, the line must be drawn somewhere between the theoretical and mathematical on the one side and the descriptive and expository on the other; and the present author has perhaps done well in confining himself to the latter field, leaving the student to seek elsewhere, as he naturally will, for a more general discussion of the theoretical principles involved. As an aid in such wider study, reference in foot notes is freely given to the more important special papers on the various topics, published in the Proceedings of the Institute of Naval Architects and elsewhere, and a careful study of which will be found of the greatest value to the thorough student of the subject.

In an appendix to the main work a discussion is given of beams and their mechanical properties. This also is non-mathematical in character and is intended to give in descriptive language such a development of the theory of the beam as will be of most use to the average reader of the book. A comprehensive index is provided for facilitating reference to any desired topic, and abundant use of cross references is made throughout the work in order to tie together distributed matter relating to the same topic.

Typographically the book is all that could be desired in such a work. The type is good, with free use of bold-face catch heads, the paper and binding excellent, and the drawings of the book of plates clearly and accurately drawn and well reproduced.

Both author and publisher are to be congratulated on the appearance of this work, which should at once take place as a standard and authoritative presentation of the present art of shipbuilding, and it may be recommended most cordially to all who are interested in this field of constructive engineering work.

Boiler Construction. By Frank B. Kleinhans. Size, 6 by 8 inches. Pp. 421, with 334 figures in the text and five folding plates. New York: The Derry Collard Company. Price, $3.00.

The purpose of the author in the preparation of this book has been the presentation in a descriptive manner of the various shop processes involved in the construction of a modern steam boiler. It has been no part of his purpose to deal with the boiler as a steam generator or with questions of general theory. It may, perhaps, fairly claim to be the only book dealing solely with the construction of modern steam boilers.

In the introductory chapter the author discusses the various types of boiler, both water tube and fire tube and for stationary, locomotive and marine service, and shows to his own satisfaction that the various problems in boiler construction are sufficiently represented by those involved in the locomotive boiler. The book itself is, therefore, concerned in actual detail with the construction of locomotive boilers, and limitation to this effect might appropriately appear in the title. There is a vast amount of detailed work, especially in the construction of bent tube boilers for marine purposes, which is not paralleled in locomotive practice. It is undoubtedly true, however, that the constructive operations required in building locomotive boilers cover the ground of ordinary boiler construction, and in the necessary limitation of scope which the requirements of space have imposed the author could not, perhaps, have done better than to take the locomotive boiler as a typical unit for discussion. The subject matter has been compiled from the most reliable sources and represents the best of modern practice. Attention has been given to the speed of operation, especially in dealing with large orders, as for railroads and in other cases involving a large amount of repetition work.

The operations required for building locomotive boilers are dealt with in a clear and thorough manner from the laying out of the sheets to the delivery of the completed boiler. Several methods are given for the development of the slope sheet, as it is not always convenient to lay out this sheet by the same method. Then follow sections on shearing, flanging, punching, drilling, bending, assembling, riveting and calking. Special sections are given on fittings, details, and on boiler shop machinery and equipment, showing points of machines liable to become broken through carelessness and giving such instructions as may best serve to keep the mechanical equipment of a boiler shop in good

running order. Valuable data are given in this connection regarding the list of dies and punches, rate of driving rivets, allowances for punching sheets in flanging, etc. A further section is given on the testing of boilers, and the book closes with a chapter of useful tables. These are intended to give, as nearly as possible, the matter necessary in connection with the constructive processes previously described.

The five folding plates show several types of modern locomotive boilers, giving a wide range of practice with this type of steam generator. The book, as a whole, is generously illustrated, well printed and bound and forms an excellent example of the modern technical printers' art.

The style of the author is clear and the arrangement of the material presented is such as to give the reader a clear and comprehensive idea of locomotive boilers. To all interested in this field and to all who are concerned with the general field of boiler construction, this book may be cordially recommended as a most acceptable addition to their working library.

Compendium of Drawing, Vol. I. Size, 6 1-2 by 9 1-2 inches. The American School of Correspondence, Chicago, Ill. Price, $5.00.

This volume comprises a series of papers on the subject of mechanical drawing, chiefly with reference to architectural work, and consists of a selection from the instruction papers in the architectural course of this school. The subject matter is treated under five principal headings, Mechanical Drawing, Shades and Shadows, Perspective Drawing, Pen and Ink Rendering and Architectural Lettering. These various papers have been prepared by men of acknowledge professional standing and represent the results of years of experience both in professional work and in the preparation of matter for the needs of persons who are obliged to study without the direct assistance of a personal teacher. The various topics of the present volume are dealt with in the clear and simple style required by these considerations, and should serve as an excellent introduction to the general subject of architectural drawing. The careful study of these papers should go far toward acquainting the reader with the principles of such work, and careful practice with the exercises given should serve to lay the foundation for technical skill as an architectural draftsman. The book may be cordially commended to all who are interested in drafting work of this character.

Compendium of Drawing, Vol. II. Size, 6 1-2 by 9 1-2 inches. American School of Correspondence, Chicago, Ill. Price, $5.00; vols. I and II, $8.00.

This volume consists of a selection of papers in the mechanical engineering and sheet metal courses of the American School of Correspondence, Chicago, Ill., and is intended particularly for students who desire to acquire some acquaintance with the art of mechanical drawing without the assistance of a personal teacher. The subject matter is treated under four heads, as follows: Working Drawings, Mechanism, Machine Design, Sheet Metal Drafting.

Under the head of mechanism the leading mechanical movements and methods for the transformation of motions and velocity are considered in an elementary manner, the subjects selected and the mode of treatment being adapted to the moderate amount of mathematical knowledge assumed on the part of the reader.

Under the head of working drawings a brief discussion is given of the general methods of representing objects on the drawing board, with special reference to the construction of the mechanism thus shown in geometrical skeleton. The subjects of dimension lines and dimensioning, tracing, blue prints, conventional representations for screw threads, various materials of construction, etc., are considered in sufficient detail for the purposes in view.

Under the head of machine design an elementary presentation is given of some of the leading problems which arise in connection with the design of mechanisms with clear and simple instructions regarding their treatment. The subject is necessarily treated largely from the draftsman's or empirical standpoint and with but slight reference to the fundamental principles or rational foundation for the operations indicated.

Under the head of sheet metal drawing a large number of illustrations are given, drawn from practical problems arising in sheet metal work and comprising chiefly intersections and developments. The reader who has mastered the material given in this section should be able to deal readily with most drawing problems which arise in connection with sheet metal work.

The book as a whole is written in the clear and simple style, characteristic of the papers issued by this school, and should prove of value to those desiring to acquire an elementary knowledge of the general subject of mechanical drawing for engineering purposes.

Lake Navigation and Nautical Astronomy. Size, 6 by 9 inches. Scranton International Text Book Company, Scranton, Pa. Price, $5.00.

This book comprises a number of parts dealing with the above topics and consisting of the papers issued for instruction purposes by the Scranton International Correspondence Schools. The book as a whole is one of a series of text books intended for persons engaged in the engineering professions and trades, or for those who desire information concerning these topics. In the preparation of these text books the writers have been limited by the moderate requirement in mathematics and general scientific preparation expected on the part of the readers, and for the most part the knowledge of mathematics required is limited to the principles of arithmetic and mensuration, while in no case is any greater knowledge needed than the simplest principles of algebra, geometry, trigonometry and the use of trigonometric tables. To effect this result the derivations of rules and formulæ are necessarily omitted, and the subject matter is limited to the actual solution of problems relating to the topic under discussion. Careful attention has been given to the guidance of the reader with regard to how, when and under what circumstances any particular rule, formula or process should be applied, and wherever possible one or more illustrative examples are given to enforce the method of its application.

Under the subject of lake and coast navigation the reader is made acquainted with the simpler principles of navigation, chiefly by compass and dead reckoning

and with special reference to the practical problems which rise in navigating vessels along our coasts and along the Great Lakes. A particular effort has been made to view the subject from the students' standpoint, and to give him plain instructions regarding the mathematical operations involved. The various terms employed are also carefully defined and explained, while an interesting section is given to the various instruments and apparatus employed, including the compass with its deviation and methods of compensation, various forms of speed log, charts, their construction and interpretation, the sextant and its use, lights and signals, rules of road, etc.

The sections on nautical astronomy discuss in detail standard methods of determining the latitude and longitude of a ship at sea by the application of astronomical laws and principles, with particular attention to star observations and Sumner's method. An abridgment of the nautical almanac for 1899 is given for use in working various practical examples.

The book as a whole constitutes an exceedingly well written elementary exhibition of the principles of navigation and nautical astronomy, and any one mastering the subject matter should be well qualified to deal with most of the problems which arise in connection with the navigation of ships, either on the high seas or in coastwise or lake service.

Navigation, Ocean Meteorology, Rules of Road, Nautical Tables. Size 6 by 9 inches. Scranton International Textbook Company. Price, $5.00.

This book forms another of the series of text books referred to in the preceding notice, and dealing with similar subject matter. In this volume the method by dead reckoning is alone considered, but an attempt has been made to give various methods of determining a ship's position at sea by this method and without the aid of astronomical observations, in the greatest variety and with fullest possible detail. Special attention is given to the determination, tabulation and compensation of compass error. In the section on meteorology the subjects of winds, tides, currents, etc., are treated in a descriptive and general manner with especial reference to such features as are of interest to the navigator. Tables are added of logarithms, trigonometric functions, Traverse tables, amplitudes, etc., and are intended to provide all necessary means of this character needed in the solution of practical problems. Sections are also given on signals, rules of road, directions for restoring a person apparently drowned, duties of master in case of collision, etc. The volume is well written in the clear and simple style which constitutes the standard of the series and should be of value to all persons interested in the topics covered by the subject matter.

Marine Boilers, Engines, Western River Steamboats. Size 6 by 9 inches. Scranton International Textbook Company. Price, $5.00.

This volume is likewise one of the series mentioned in the preceding notices. The subject matter deals with the propelling machinery of steam vessels, especially from the standpoint of the sea-going engineer. The aim throughout has been to serve as an aid to the marine engineer with reference to preparation for examination for license. In consequence of this purpose the subject of design has been limited to the requirements of this examination, and the rules and formulæ given are those prescribed by the United States Steam Boat Inspection Service. A considerable section of the volume is given to the machinery of western river steam boats, with especial reference to their peculiarities in valve gear, in boilers and in special auxiliaries. Standard types of marine boilers are plainly described with especial reference to the principal fittings and auxiliaries, and with sections on wear and tear, corrosion, inspection, priming, explosion, repairs, trials, etc. The leading features of marine engines are taken up in a similar manner, and a plain discussion on valves and valve gear is given, with reference to the usual problems met with in marine practice. In this connection it is hard to understand why the Allen valve or a Meyer cut-off valve should have been given space in a discussion of modern marine gears. Brief mention is made of paddle wheels and screw propellers with the solution of elementary problems in connection with their operation. Indicator cards and the determination of I. H. P. form the subject of careful and clear treatment. Condensers and air pumps are also briefly considered, with some mention of other auxiliaries.

The book as a whole gives an incomplete, though fairly correct idea of the field of operation covered by the marine engineer, and it should prove of service to those for whom it was specially prepared.

Dock Engineering. By Brysson Cunningham. Size, 6 1-2 by 9 inches. Pp. 559, with 569 figures in the text, including several folding plates. London: Chas. Griffin & Co.; Philadelphia: J. B. Lippincott Company. Price, $6.00.

This book deals with that part of the broad province of maritime engineering which relates to stationary structures, provided for the convenient operation of ships in relation to the exchange of passengers and cargo with the land. The dock is in essence the point of contact of the ship with the solid earth. From its very nature its construction is difficult, the foundations usually under water and complicated by the special conditions which exist at and near the water's edge. The aim of the author in the present work has been to deal, thoroughly and in detail, with the general principles which relate to this field of engineering and to illustrate these principles by a large number of examples drawn from the best current practice. The book has been prepared, primarily, for the student, but in addition it should prove of value for reference purposes to the expert engineer, and, indeed, to all who are in any way concerned with this branch of engineering. The work is divided into twelve chapters, dealing in detail with general dock design, with the materials of engineering available for such purposes, with the various constructive appliances at the service of the dock engineer, with dock and quay walls, entrances, passages, lockes, jetties, wharves, piers, dock gates, caissons, with transit sheds and warehouses, with dock bridges, with graving and repair docks and with the working equipment incidental to the complete usefulness of the dock, with reference to its primary purpose. These technical chapters are preceded by a historical and general discussion of the subject of docks

from the decriptive viewpoint. While the work as a whole is mostly descriptive, the author has introduced where necessary, theoretical discussions of various items having special relation to the subject matter. The descriptions are clear and well written and the examples are drawn from a wide field of practice, making of the book an excellent compendium of the best types of modern dock construction. The illustrations, press work and binding are all in the well known and standard style of the publishers.

Loci in Mechanical Drawing, Part III, Piston Acceleration. By A. MacLay. Size 5 1-2 by 8 1-2 inches. Pp. 120, with 74 diagrams in the text. Manchester: Technical Publishing Company; New York: D. Van Nostrand Co.

The aim of the author in this work has been to introduce the student to problems dealing with velocity and acceleration, particularly as met with in the various mechanisms which may form the geometrical skeleton of a steam engine of the slider crank order. To this end the various forms of the single, double and swinging block slider crank are examined with reference to the relative velocities and accelerations of the various parts. The examination is taken up both from the analytical and graphical standpoints, though for the actual solution of problems the latter is usually preferred, while the analytical discussion serves to generalize the treatment, and to supplement most helpfully the purely graphical methods. Throughout the book and especially in the case of the piston acceleration curve in the ordinary slider crank, different methods have been shown for arriving at the same result. These are given for completeness of treatment and to furnish a choice of method as the designer may desire.

The book as a whole deals with the one problem of velocity and acceleration in slider crank chains as used in steam engine mechanisms, only one of the many connected with steam engine design, and yet one of great interest and importance to the designer, especially with the ever increasing importance of the subject of inertia forces and balancing. The comprehensive and clear treatment of this subject in the present work should at once make the book a standard of reference on this topic, and it should form a most acceptable addition to the working library of every draftsman and designing engineer.

Workshop Costs for Engineers and Manufacturers. By Sinclair Pearn and Frank Pearn. Size, 10 by 14 inches. Pp. 28, with 42 folding sheets. Technical Publishing Company, Manchester. Price $7.50.

The increasing interest shown in books on the general topic of costs and cost accounting is an indication of the growth in the importance of these subjects for the industrial engineer. The present work has been published at the suggestion of engineers, accountants, and others who were desirous of full information regarding the methods employed by the authors in connection with their own manufacturing work. The book as a whole consists of some general discussion of the subject of costs and cost accounting, treated under the following heads: the Nomenclature and Registration of Patterns and Materials, the Recording and Analysis of Labor, Manufacture or Repetition Work, Contract or Special Work.

In order to exemplify the principles thus developed the authors make chief reference to the actual methods employed at the works of Messrs. Frank Pearn & Company, Limited, Manchester, where they have now been in operation some twenty years. A large number of facsimilies of their forms, pattern lists, etc., are shown, comprising, in fact, the chief bulk of the volume. It has been pointed out, however, that the selection of these examples is simply for the convenience of the reader, and that the advantages of the system are by no means confined to this class of manufacture, much less to the particular examples selected. The authors point out in particular that the weights, moneys, and all items pertaining to values and indentification are for the purpose of illustration only, and do not represent the actual costs or weights of the articles to which they refer. By means of these changes the authors have been able to give in the fullest detail their system of cost accounting without at the same time publishing at large the actual costs involved in their business, information which they would scarcely desire to make public.

The work as whole forms thus a unique example of the cost accounting system of a large and successful engineering establishment, and shown in the most complete detail for the benefit of all who are concerned in works management or in the general subject of the cost accounting of manufacturing establishments. The volume will, therefore, be found of the greatest interest to all such, and may be recommended to their careful examination.

PERSONALS.

Edwin E. Mager, formerly ship draftsman with the New York Shipbuilding Company, has accepted a similar position with the Bureau of Construction and Repair, Navy Department, Washington, D. C.

Arthur H. Sherwood has resigned his position in the drafting room of the Bureau of Construction and Repair, League Island Navy Yard, to become associate professor in marine engineering and naval architecture at Lehigh University.

Carl C. Thomas has been appointed assistant professor in marine engineering at Sibly College, Cornell University. Until recently Mr. Thomas was one of the corps of instructors in the mechanical department, University of the City of New York.

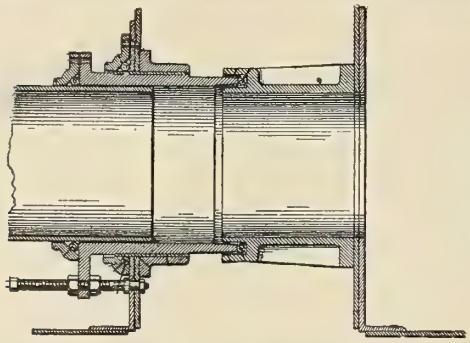
Walter W. Edwards, former professor in steam and marine engineering at the International Correspondence School, Scranton, Pa., is now with the Hawley Down Draft Company, in charge of the Pittsburg office.

Lewis Nixon, of former United States Shipbuilding fame, is reported to have leased the Ramsey shipyard, at Perth Amboy, N. J., and is now in Russia, negotiating for the sale of merchant ships and construction of warships. The Mexican government has begun suit in the New York Supreme Court to recover $75,000 damages against Mr. Nixon and the United States Fidelity & Guaranty Company, alleging that the new gun boats *Vera Cruz* and *Mexico*, built at the Crescent ship yard, failed to comply with contract as to speed, coal consumption and torpedo plan.

SELECTED MARINE PATENTS.

762,872. PIPE JOINT FOR FLOATING DRY-DOCK PONTOONS. NILS A. BERNER, SPARROW'S POINT, MD.

Claim.—1. The combination, with two pontoons, of a joint or connection comprising a male and female gland, one of which is adjustable.

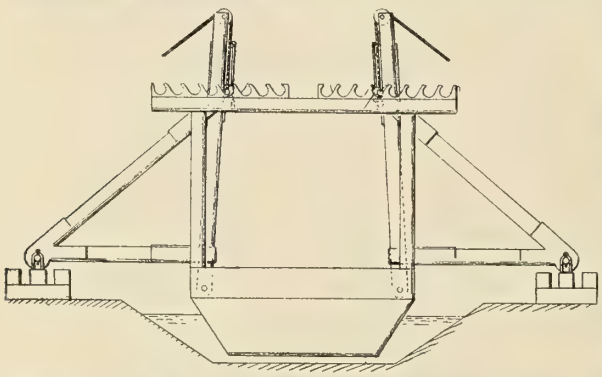


2. The combination, with two pontoons, of a joint or connection comprising a male and female gland, one of which is adjustable, and packing held between the joints of the connection whereby to render them waterproof. Four claims.

762,923. SPEED GOVERNOR FOR SHIP PROPELLERS. CHARLES E. MILES, POMONA, FLA., ASSIGNOR OF ONE-HALF TO FRED. H. WILLSON, PALATKA, FLA.

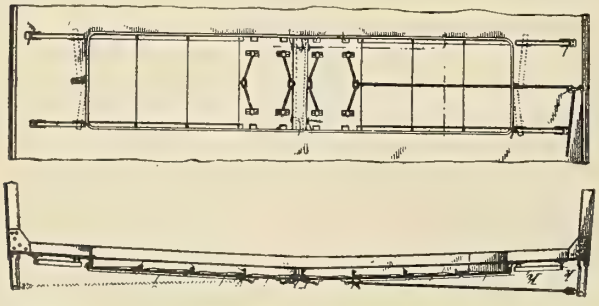
Claim.—1. In a speed governor for ships, the combination with propelling means, means disposed within the ship for regulation of the speed of the propelling means aforesaid, and a hydro-regulator disposed beneath the surface of the water adjacent the propelling means for operation of the speed-regulating means within the ship, said regulator being adapted for actuation by pressure of the water against the upper side thereof. Four claims.

762,950. ANCHOR FOR DREDGING MACHINES. JERRY SHERWOOD, HEBRON, IND.



Claim.—1. In an anchor for dredging machines, triangular frames pivoted on the machine, means to pivotally secure said triangular frames outside of said machine, and pawls and ratchets connecting said frames with the machine. Four claims.

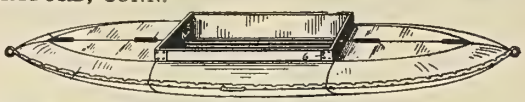
763,493. HATCH COVER. ROBERT R. LACEY, DETROIT, MICH.



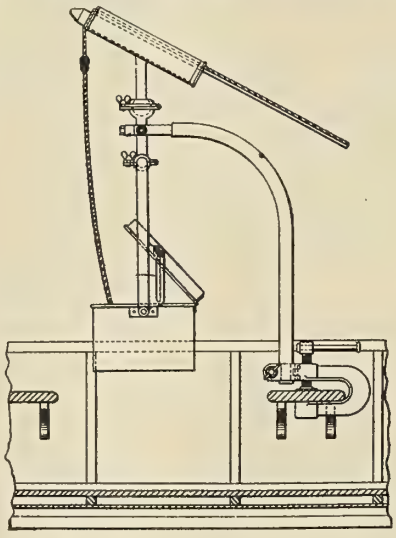
Claim.—1. The combination of a plurality of hatch cover sections provided at their adjacent edges with detachable interlocking portions and adapted to slide one upon the other to open the hatch.

7. The combination of a plurality of hatch-cover sections provided at their adjacent edges with detachable interlocking portions, one section having raised tracks provided with beveled ends, whereby the other section is caused to ride upon said tracks and said interlocking portions are disengaged, by moving said last-mentioned section horizontally. Twenty-two claims.

764,267. STEAMBOAT PROPELLER. WORTHINGTON S. BAKER, PITTSBURG, PA. One claim.

764,473. FOLDING BOAT. CHARLES F. KILGORE, HARTFORD, CONN.

Claim.—1. A folding boat, comprising a middle section, longitudinally-divided end sections and means for securing the end sections to the middle section. Eleven claims.

764,682. LINE-THROWING APPARATUS. WILLIAM SCHERMULY, POPLAR, COUNTY OF MIDDLESEX, ENGLAND.



Claim.—1. A line-throwing apparatus comprising, in combination, a rocket trough, a gimbal ring in which said trough is pivoted, a davit in which said ring is revolubly mounted, and a counterbalance connecting with said trough. Seven claims.

764,741. MEANS FOR NAVIGATION. CAREY A. MANKER, PEARL, ILL., ASSIGNOR TO MANKER-HEAVNER NAVIGATION COMPANY, ST. LOUIS, MO., A CORPORATION OF ARIZONA. Nine claims.

764,958. BOAT PROPELLER. JOHN W. RAINE, SEATTLE, WASH. Eight claims.

PERSONAL.

Mr. Louis Terven, E.E., has recently been appointed chief electrician of the Nernst Lamp Company, Pittsburg, Pa. Mr. Terven was for some time electrician of the United States navy yard, Port Royal, S. C., which position he resigned to enter the experimental laboratory of the Nernst Lamp Company. Later he was given charge of the chemical engineering department of this company.

Monthly Shipbuilding Returns.—The Bureau of Navigation, Department of Commerce and Labor, reports 118 sail and steam vessels of 16,171 gross tons were built in the United States and officially numbered during the month of July, 1904. The largest steam vessel included in these figures is the *Ontario*, 3,082 gross tons, built at Camden, N. J., for the Merchants' and Miners' Transportation Company.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 137 vessels of 51,607 gross tons built in the United States and officially numbered during the month of June. The largest steel steam vessel included in these figures are the *Minnesota*, 20,718 gross tons, built at New London, Conn.; *Sahara*, 5,785 gross tons, built at Lorain, Ohio; *City of Atlanta*, 5,433 gross tons, built at Chester, Pa.; *Martin Mallen*, 4,635 gross tons, built at Cleveland, Ohio.

Marine Engineering

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MACHINERY OF THE ITALIAN BATTLESHIP REGINA MARGHERITA.

The Italian warship *Regina Margherita* has just completed her official contract steam trials, and has attained most satisfactory results. She is a battleship of 13,430 tons displacement, 427 feet long, 78 feet beam and 27 draft, built at the royal dockyard of Spezia. The machinery was constructed by the firm of Gio. Ansaldo, Armstrong & Company, of Genoa, at the company's engineering works of Sampierdarena.

ITALIAN BATTLESHIP REGINA MARGHERITA ON TRIAL AT 19.3 KNOTS SPEED.

The machinery consists of two main engines fitted with all the necessary auxiliary engines, steam being supplied by twenty-eight Niclausse water-tube boilers. Each set of engines is placed in a separate engine room, divided by a longitudinal water-tight bulkhead, and each engine room is in all respects exactly similar and entirely independent of the other.

The boilers are placed in six separate compartments, forward the engine rooms, three on port side and three on starboard side, divided by a longitudinal water-tight bulkhead. The working pressure of the boilers is of 300 pounds, being reduced to 250 pounds at the engine.

The main engines are of the four-cylinders triple-expansion type, the diameter of the cylinders being 37, 60 1-4, 69 1-4, and 69 1-4 inches; the stroke is 47 1-4 inches. The engines are balanced on the Schlick system, the two low-pressure cylinders being at the center and the high and intermediate cylinders at the ends, and here it may be said that the balancing proved most effective. Stephenson link motion is adopted for working the valves, which are piston type on the high and intermediate-pressure cylinders, and of the double-ported slide design on the low-pressure cylinders. The reversing gear is all-round type, fitted with a double-cylinder engine.

The screws are inward turning, and the starting plat forms are in the center of the ship.

The cylinders are independent castings; the two low

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pressure cylinders form a solid body with the low-pressure receiver placed between the two cylinders; the high and intermediate cylinders are each secured to the low-pressure cylinders by flanges and bolts. Each cylinder is supported by two cast-steel columns at the front, and by one cast-steel frame at the back. The bedplates are of cast-steel.

The pistons, crossheads and steam-chest covers are of cast-steel. The piston rods and connecting rods are of Siemens Martin steel, the connecting rod bodies of the low-pressure cylinders are hollow for balancing purpose. White metal is fitted in the bearings of the connecting rod gudgeons and crank pins, and it was very successfully tried. Each crosshead is fitted with a cast-steel slipper lined with white metal on rubbing surfaces; the guide bars are of cast iron, bolted on the back standards.

The crankshafts are hollow, and each consists of four interchangeable pieces, 18 5-16 inches external diameter, both at journals and at the crank-pins. Each crank-pin is 20 7-8 inches long; each engine has eight main bearings, with a collective length of 13 feet 8 inches. The thrust shafts have diameter of 18 5-16 inches; the thrust blocks are of the horse-shoe type, with a collective surface of 15 square feet. The propeller shafts are 18 5-16 inches diameter. All crank, thrust and propeller shafts are of best mild steel.

The propellers are three-bladed; 18 feet 8 1-2 inches diameter by 19 feet 8 3-4 inches pitch. The bosses are of gun metal, and the blades are of manganese bronze.

The two main condensers are separate and placed in the wings; they are cylindrical, with shells of sheet brass, doors and tube plates of gun-metal; the total cooling surface is 20,500 square feet. The water is supplied by four circulating pumps, each being driven by an independent compound engine, with runners 43 3-8 inches in diameter, and are each capable of discharging 1,000 tons of water from the bilge per hour. There are four main air-pumps worked by the intermediate and aft low-pressure cylinders, 26 inches in diameter and 20 1-2 inches in stroke; there are also two auxiliary Blake air pumps for maintaining a vacuum in the main condensers when the main engines are shut down; they are 10 1-4 inches in diameter and 8 inches in stroke.

The exhaust steam from all auxiliary machinery on board is so connected that it may either exhaust up the funnel or into an auxiliary condenser in each engine room. Each of these condensers has its own air and circulating pump entirely independent of those for the main condensers, and they are driven by independent engines. The combined cooling surface of these two auxiliary condensers is 2,400 square feet; the tube casings, like those of the main condensers, are of sheet brass.

Two double-cylinder turning engines are conveniently placed on the aft columns for turning the main engines. This is effected by compound worm-gearing, through which the main engines may be turned completely round in seven minutes, with a steam pressure of 100 pounds. A hand-gear has also been fitted.

There are also several auxiliary engines in the main engine rooms, to which reference may be made here and before we enter upon a description of the boilers. The distilling machinery for the purpose of furnishing fresh water for the boilers consistts of four sets of Ansaldo evaporators with pumps complete, capable of furnishing collectively 80 tons of fresh water per day. There are four large vertical fire and bilge duplex pumps; two bilge hand-pumps; two oil hand-pumps; two electric fans and four electric extractors for the purpose of aerating the engine rooms.

The drain water service consists of four tanks, two in the engine rooms and two in the boiler rooms, into which are discharged all the drains from the main and auxiliary engines, steam pipes, etc.; two steam pumps are fitted in the engine rooms for discharging the drain water from the tanks into the hotwells or overboard. There are in the engine rooms two hotwell tanks and two feed tanks, the former taking the discharge from the main and auxiliary air pumps. Two hotwell pumps draw the water from the hotwell tanks and discharge into the feed tanks through the filtering apparatus, consisting of four sets of Harris filters.

BOILERS.

As already stated, the boilers are of Niclausse water-tube type, twenty-eight boilers in all. Each has 15 headers with 18 tubes, making altogether 420 headers with 7,560 tubes. The tubes are of 3 1-4 inches, outside diameter, and 7 feet 10 1-2 inches long. The headers are of malleable cast iron, the tubes of steel, solid drawn. Each boiler has one fire-box and three fire-

MARINE ENGINEERING DATA CARD. OCTOBER, 1904.

Name—Regina Margherita. **Nationality**—Italian. **Type**—Battleship.

Launched—1903. **Builder**—Hull-Spezia Royal Yard. **Owners**—Italian Navy.

Length.....427 ft.
Breadth ..... 78 "
Draft, trial forward, 27 ft., aft..... 27 "
Displacement.....13,000 tons
Engines: Number .....two
Type.....four-cylinder, triple expansion
Cylinder diams.....37, 60 1-4, 69 1-4, 69 1-4 ins.
Stroke.....47 1-4 "
Valves, piston on H. P. and I. P.,
slide on L. P.'s.
Shafting, diam .....all 18 5-16 ins.
Crank pins.....18 5-16 x 20 7-8 ins. long
Condensers, 2 main, total surface,
20,500 sq. ft.
Condensers, 2 auxil., total surface...2,400 sq. ft.
Air pumps, 4 main d. c.,
26 ins. diam. x 20 1-2 ins.
Propellers 3 manganese bronze blades,
gun metal bosses
Diameter.....18 ft. 8 1-2 ins.
Pitch..... 19 " 8 3-4 "
Boilers: Number.....28
Type.....Niclausse, water-tube
Tubes.....3 1-4 ins. o. d. x 7 ft 10 1-2 ins.
H. S., total.....50,310 sq. ft.
G. S., " ..... 1,555 "
Weight of machinery complete,
including water in boilers, 1,550 tons

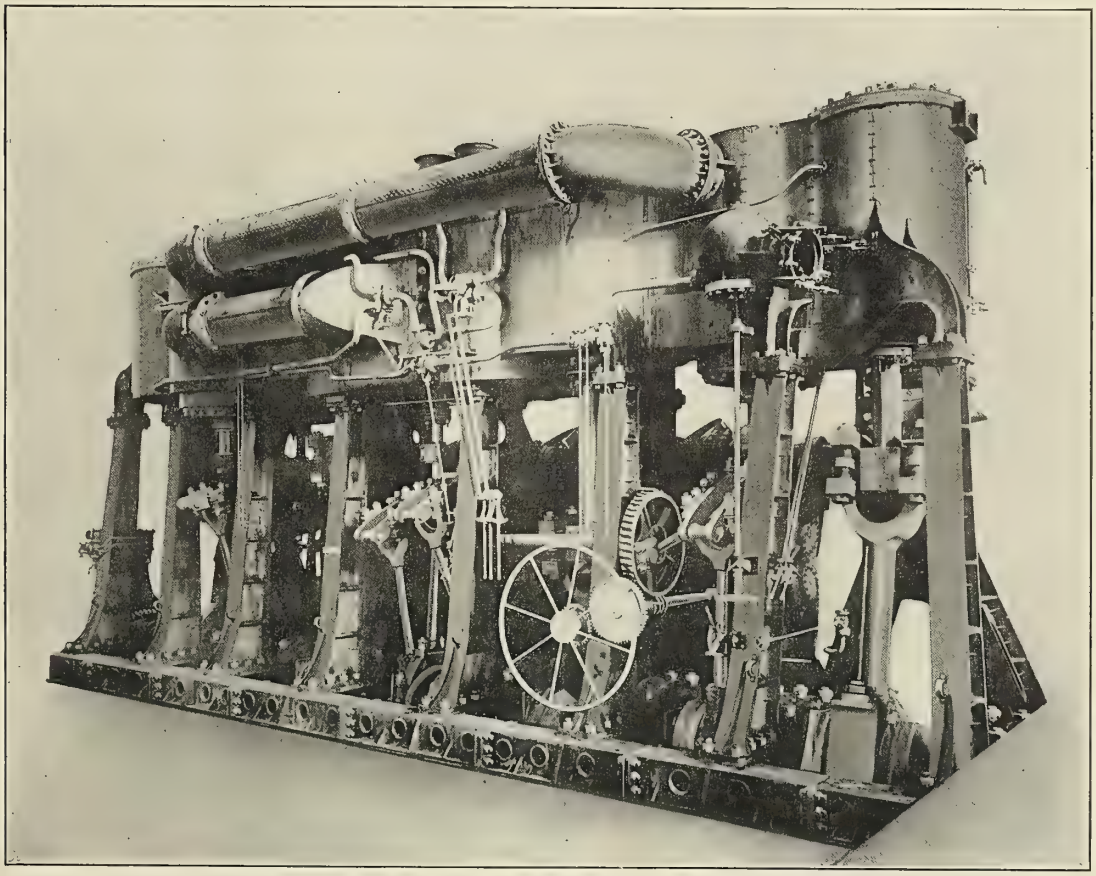
doors. The aggregate heating surface of the twenty-eight boilers is 50,310 square feet, and the total grate area is 1,555 square feet.

There are three smoke-pipes, 92 feet high above grate bars. The boiler rooms are arranged for forced draft in closed stokehold, but non-airtight. The maximum air-pressure admitted, 3-8 inch, is furnished by twelve electric fans. Twelve electric ash hoisting engines, with electric brake and automatic stop-gear, are fitted for removing ashes from each of the boiler rooms and discharging them overboard.

The feed arrangement for supplying the boilers comprises a main and auxiliary system of pumps and pipes, which are separate and independent of each other. There are six main feed pumps and six auxiliary feed pumps, all of the same sizes, of duplex type, fitted in the boiler room. All the pumps draw from the feed tanks and from the reserve tank; the main feed pumps discharge into the boilers through the automatic feed regulators; the auxiliary feed pumps discharge into the boilers through the hand-regulating feed valves.

The main steam supply is conveyed by six lines of steel steam pipes, one from each of the six groups of boilers, three lines being arranged on each side of the longitudinal central bulkhead. These lines are each entirely independent of the other, as are also the risers from the boilers. The port lines lead to a separator in the port engine room, and thence the main steam pipe leads to the port engine. The starboard arrangement is identical, and a transverse branch fitted with stop valve connects the two mains. Any boiler may be cut off from the system without interfering with the performance of the others in the compartment, as may also be cut off any compartment from which one of these main steam pipes leads, without affecting the working of the other compartments.

The machinery is fitted with all the latest apparatus usual in vessels of this class, including Molinari's electric counters and Perroni's automatical signaler for regulating the rate of firing, which was found very useful.



FOUR-CYLINDER, TRIPLE-EXPANSION ENGINE OF THE ITALIAN BATTLESHIP REGINA MARGHERITA.

The total weight of machinery complete, including water in the boilers, is 1,550 tons.

TRIALS.

The official trials took place in the Gulf of Genoa in the past July, and it may be said at the outset that they have proved eminently satisfactory. The Italian Government was represented by Rear-Admiral Annovazzi, Commander Viale, Colonel Valsecchi, Major Traverso, Captain Quarleri of the Royal Naval Corps of Constructors, Major-Engineer Pinto, and Captain-Engineer Palestino. The firm was represented by Comm. A. Omati, the manager of Messrs. Ansaldo, Armstrong & Company engineering works at Sampierdarena, and by M. Vallino, chief engineer of the mechanical drawing office. The contract fixed one 6 hours' steam trial at 16,000 I.H.P. with natural draft,

and coal consumption not greater than 1.87 pounds per I.H.P. hour; and one 1 1-2 hours' steam trial at full power of 19,000 I.H.P., with assisted draft at an air pressure not greater than at 3-8 inch.

The first trial on natural draft took place on July 16, 1904; the mean power developed during the 6 hours' run was 17,782 I.H.P.; the coal consumpttion was 1.84 pounds per I.H.P. hour.

The second trial on assisted draft took place on July 21, 1904; the mean power developed during the 1 1-2 hours' run was 20,664 I.H.P., with an air-pressure of 3-16 inch, and a coal consumption of 1.98 pounds per I.H.P. hour.

In both the trials all the main and auxiliary engines worked very satisfactory, and the boilers easily produced the steam supply. The results of the two trials are tabulated below.

Before concluding this description it should be mentioned that the whole machinery was constructed by Gio. Ansaldo, Armstrong & Company; the main and auxiliary engines and the Niclausse boilers coming from the mechanical works of the firm in Sampierdarena; all the cast-steel for the engines and malleable cast-iron pieces for the boilers coming from the firm's steel works at Cornigliano; the propellers and bronzes generally from the Delta works of the firm at Cornigliano; and finally the electric motors for the fans, extractors, ash-hoisting engines, etc., were constructed at the electrical works of the firm at Cornigliano.

TRIAL DATA. MARINE ENGINEERING DATA CARD. OCTOBER, 1904.

NAME—Regina Margherita. NATIONALITY—Italian. TYPE—Battleship.

LAUNCHED—1903. BUILDER—Engine, G. Ansaldo, Armstrong and Co. OWNERS—Italian Navy.

	Natural Draft.		Forced Draft.	
Date	July 16, 1904.		July 21, 1904.	
Duration	6 hours		1 1-2 hours	
Draft, forward and aft	27 ft.		27 ft.	
Displacement	13,000 tons		13,000 tons	
Air pressure	0		3-16 ins.	
Steam pressure, boilers	261 lbs.		279 lbs.	
	STB.	PORT.	STB.	PORT.
" H. P. steam chest, lb.	235	230	242	240
Vacuum, ins.	26.5	26.3	26.1	26.3
R. P. M.,	115.4	114.6	120.8	121.2
I. H. P., mean. High	2,800	2,750	3,108	3,218
Intermediate	3,008	2,986	3,375	3,371
Low, forward	1,550	1,537	1,894	1,905
" aft	1,609	1,548	1,889	1,908
I. H. P., total, mean	8,967	8,815	10,262	10,402
I. H. P., collective, main engine	17,782		20,664	
Speed of vessel	19.3 knots		20.2 knots	
Coal per I. H. P., hour	1.84 lbs.		1.98 lbs.	

NAVIGATION, SHIPBUILDING, AND NAVAL ENGINEERING SCHOOLS IN GERMANY.*

BY E. C. MEYER, U. S. DEPUTY CONSUL, CHEMNITZ, GERMANY.

GERMAN SCHOOLS OF NAVIGATION.

Early schools.—The Prussian government turned its attention to the establishment of schools of navigation as early as the beginning of the nineteenth century. One of the first of these schools is reported to have been organized at Danzig in 1817. The purpose of this institution was declared to be the education of competent sailors, pilots, and captains. In the absence of an independent school building, and of sufficient funds to erect one, the new school had to content itself, for the time being, with four rooms of an old church. The course of study occupied two years and was eminently practical. In fact, in all its essentials, the curriculum remains the same to-day.

In the course of the decades following the establishment of the school at Danzig, a number of similar institutions were founded elsewhere. By 1855 such schools had been organized at Memel, Pillau, Grabow, and Stralsund. The attendance at this time was 246, and by 1863 the number had been swelled to 304. More schools were soon added, for their value was proved by the results of the old schools. In close succession there followed schools at Barth in 1865, at Timmel and Leer in 1866, and at Geestemünde in 1870.

Preparatory schools.—It was deemed highly important to provide means whereby the young boy might be started as early as possible in the study of his profession, as it was claimed to be necessary to enter the seaman's profession at a comparatively early age, even at a sacrifice of part of the general education that might otherwise be obtained. For this reason preparatory schools were organized in connection with all the regular schools of navigation, while in some cases special preparatory schools were even established independently. Experience has shown that many of the students who attend the preparatory schools drop out on completing the work without entering the regular schools. Among these are numbered students who are too poor to afford a higher education, as well as those who from the start were undecided as to just what profession they would enter.

Present navigation schools in Prussia.—The popularity and value of the schools of navigation are well shown by their wide distribution throughout Prussia. In 1902 institutions of this class were located at Pillau, Danzig, Grabow, Stralsund, Barth, Altona, Flensburg, Apenrode, Geestemünde, Timmel, Leer, and Papenburg. Each of these schools has a preparatory school connected with it, while similar preparatory schools have been established independently at Swinemünde, Stalpmünde, Zingst, Prerow, Grünendeich, Groh, Emden, and Westrhauderfehn.

Attendance.—The total attendance at the preparatory schools, including the independent ones and those associated with regular schools, was 828 in 1901. During the same year 472 pupils were enrolled at the regular schools, of whom 333 studied as pilots and 39 as captains

Entrance requirements.—For admission into the schools of navigation the applicant must show familiarity with the German language; knowledge of the funda-

*Taken from U. S. Consular Report.

mentals of fractions, decimals, proportion, extraction of roots; knowledge of algebra and geometry, especially of triangles and circles; knowledge of the elements of political and nautical geography. The possession of these educational requirements is tested by an entrance examination.

Curriculum.—The two years' course of study in schools of navigation includes the following branches: arithmetic, plane geometry, stereometry, plane trigonometry, spherical trigonometry, mathematical geography, astronomy, drawing; description and use of logs, half-minute glasses, compasses; use of Mercator's charts; calculation of currents in the sea; calculation of time on board; calculation of distances; hydraulics, statics, wind, sails and their manipulation; manœuvering and control of ships; shipbuilding; duties and obligations of captain to his men and cargo, and in loading, clearing, and sailing, quarantine, stranding, salvage, etc. It is hardly necessary to call particular attention to the eminently practical character of this series of studies in preparing a boy for a career on the seas.

No examination is required for admission into the preparatory schools, and the curriculum, with the hours of study per week, is as follows: German, 6; arithmetic, 12; geometry, 8; geography, 4; drawing, 2. This gives a total of 34 hours a week. In addition 2 hours a week are generally devoted to a study of first aid to the injured, under the guidance of a man with a professional medical training.

Schools for inland navigation.—Prussian schools for the instruction of pilots, sailors, and other deck hands employed in inland navigation are found at the following places: Aken, Tangermünde, Parez, Wittenberg, Lauenburg, Schönebeck, Rogätz, Elster, Rosenburg, Mühlberg, Ruhrort, Zehdenick, Bredereiche, Havelberg Alsleben, Fürstenberg, Wettin, Thorn, Neuendorf, Tschicherzig, Pretzsch, Plaue, Pritzerbe, Fürstenwalde, Polenzig, Lehnin, Coblenz, Linum, and Hameln.

These schools, which were established in the years from 1888 to 1902, were attended by 325 students in 1901. Two-thirds of all expenditures which are not covered by tuition fees are met by the state, and the rest is met by the cities, chambers of commerce, sailors' unions, and other interested organizations. The municipalities, chambers of commerce, and other local bodies also generally furnish rooms, heating, light, and like equipment.

SCHOOLS FOR NAVAL ENGINEERING.

Early schools.—In 1879 the German emperor by special ordinance prescribed regulations for the holding of examinations for those who desired to enter the profession of naval engineer. While these regulations were not severe, but merely required sufficient knowledge to insure competent service, it was found that the applicants as a body were utterly unqualified for the work. They came largely from the locksmith and firemen trade, and proved poor recruits for the rapidly developing navy and merchant marine of the empire.

The result was that two schools for naval engineering (See-Dampfschiffmaschinistenschulen) were established —one at Flensburg in 1886, and one at Stettin in 1890. At Flensburg naval machinists from the first to the fourth class were educated, and at Stettin only those from the second to the fourth class. The Flensburg school therefore offered the higher grade of instruction.

Curriculum.—The work for machinists of the fourth class, that is, of the lowest rank, involves the following studies: German, arithmetic, mechanical engineering, physics, and technology. A total of 24 hours a week are devoted to these studies for the period of two months. Machinists of the third class study German, arithmetic, mechanical engineering, physics, technology, and electrotechnics. The latter branch characterizes the third class. A total of 30 hours a week are devoted to these studies for the period of two months. Machinists of the second class study mechanical engineering, drawing, mechanics, physics, technology, electrotechnics, arithmetic, geometry, German, and English. A total of 45 hours a week for the period of five months is devoted to these studies. The studies for the first class of machinists are German, English, plane geometry, stereometry, arithmetic, trigonometry, mechanics, physics, chemistry, mechanical engineering, and drawing. Forty-five hours a week are devoted to these branches for the period of five months.

While these periods of study for the various courses are apparently very short, much more work is accomplished than the time spent would indicate, for the emphasis placed upon previous practical experience on the part of applicants makes it possible to give a large amount of theoretical instruction in a comparatively short time. In 1901 the school at Flensburg was attended by 47 students and the one at Stettin by 27.

SCHOOLS FOR SHIPBUILDING.

An important department in the technikum, or institute of technology, at Bremen, is the school for shipbuilding. This institution, like the school for naval engineering, is a distinct factor in the upbuilding of the German merchant marine. One institution trains the men who build the ships; the other, those who man them.

Entrance requirements.—In contrast with the schools for naval engineering just discussed, the shipbuilding schools impose considerable educational requirements for admission, in addition to practical experience. The applicant must possess a certificate entitling him to the privilege of one year's military service as a volunteer, which means that he must have graduated from a six-year secondary school, or completed at least six years" work at a nine-year secondary school, such as the classical Gymnasium, the semi-classical Realgymnasium, or the non-classical Ober-Realschule. The average age of graduation from the six-year secondary school is between 16 and 18 years. Those who lack such an education may be admitted upon examination, or they may attend a preparatory class with unrestricted admission. In addition to these educational requirements the applicant must have had at least one year of practical experience in the trade. It is a noteworthy fact, and one that cannot be too highly commended, that the German industrial schools almost invariably require a certain amount of practical experience for admission to their classes.

Length of courses.—The course in the preparatory school (Vorklasse) occupies half a year and begins in October of each year. The regular course of the school occupies two years and begins in April.

Tuition fees.—The tuition fee for the regular course is 100 marks ($23.80) a half-year, or 400 marks ($95.20)

for the two years of work. The fee must be paid in advance at the opening of each semester. Books and other study material are extra.

Curriculum.—The following table permits the reader to see at a glance just how the studies are grouped for the preparatory class and for the regular semester's work:

CURRICULUM OF SCHOOL FOR SHIPBUILDING OF BREMEN TECHNIKUM.

Studies.	Hours per Week.				
		Lower Class.		Upper Class.	
	Preparatory C	First Semester.	Second Semester.	Third Semester.	Fourth Semester.
German	4	2	..	..	..
Bookkeeping	..	1	1	..	..
English	..	..	2	3	2
Arithmetic	12	..	..	..	..
Planimetry	6	..	..	..	..
Trigonometry	..	2	..	..	..
Stereometry	..	2	..	..	..
Review of mathematics	..	2	2	..	..
Mechanics	..	5	2	2	..
Strength and resistance of materials	..	3	2	2	1
Graphostatics	..	..	2	..	..
Physics	..	3	3	..	..
Chemistry	..	2	2	..	..
Descriptive geometry	6	4	..	..	..
Freehand drawing	4	2	..	..	..
Shipbuilding drawing	..	6	8	8	10
Estimates in shipbuilding	..	..	..	..	1
Laying off ship on mold loft	..	..	..	6	..
Mechanical technology	..	..	3	3	..
Constructive naval engineering	..	..	5	8	10
Shipbuilding (theoretical)	..	4	6	8	9
Electrotechnics	..	..	..	..	3
Commercial geography and German history	2	..	..	..	..
Vertical penmanship	2	..	..	..	..
Total number of hours	36	38	38	40	36

That a lad of average attainments will develop into a capable shipbuilder after completing a course of study such as the above seems obvious, and the popularity of the Bremen school certainly speaks for the value of the training to be obtained there.

GOVERNMENT AID.

During recent years the German government has been paying considerable attention to the promotion of schools for navigation, shipbuilding, and naval engineering, for these institutions are powerful factors in the attainment of her great ideals of commercial supremacy and naval power. The marvelous development of the German merchant marine, as well as of the empire's naval armament, is a matter of common knowledge. A rapidly increasing number of trained young men are required for the manning of these merchant vessels and war ships. So great is the call that the schools can only with difficulty meet it. Applicants for admission to the courses are not infrequently turned away because of lack of accommodations.

In recognition of the growing need for education in this line plans have been made for new schools. At Danzig, for example, a splendid new high school for shipbuilding and related trades is to be opened next year. Courses adapted to the needs of naval engineers, shipbuilders, and navigators are also being given at a number of the technical high schools of the country. It is from these institutions that there are daily going forth the men who will continue the great work of building up the German merchant marine and naval power—a work which is being carried forward with such astonishing rapidity, persistence, and intelligence as to challenge the admiration of the world.

NAVAL ACADEMIES OF RUSSIA AND JAPAN.

In order to understand the fighting strength of the Russian and Japanese navies, one must know the manner and extent of the education of the officers of the two fleets. The *Navy League Journal* gives an interesting sketch of the naval academies of Russia and Japan, and by way of introduction states that the average age of the admirals of the two fleets is fifty-nine years for Russia, forty-nine for Japan, and the ages of the captains of the battleships are fifty-two and forty-six respectively. Continuing, the *Journal* states:

The Russian Naval Academy is at St. Petersburg and was founded about 200 years ago.

Examinations for entrance are held once a year, in August, and are open to all boys between the ages of 12 and 14 who are the sons of naval officers or noblemen. About 100 cadets enter each year. The course at the academy is six years. During the first three years the cadets receive only an ordinary academic training, nothing professional being taught. The professional education begins with the fourth year. It consists of theory on shore during the winter and training afloat in masted ships during the summer. The school year begins on September 15 and ends on May 15. Three cruises are made, dealing with general practical work, and a fourth of four months' duration deals especially with navigation. Before graduating, there are two examinations: first, a theoretical one, held at the school in the spring; and second, a practical one, in the fall on board ship after the final four months' cruise. Cadets who pass both examinations are promoted to *mitchmen*—that is, ensigns. To be promoted to this grade it is also necessary for the cadets to have spent two years on board ship during their time at the academy.

The corps of cadets is divided into six companies, each class forming a company. Of the cadets who enter each year, a certain number—those who pass best—are supported by the government. For instance, in 1901 there were only 75 vacancies; the first 60 cadets were admitted at the expense of the state; the remainder had to pay about $175 a year. As soon as a boy successfully completes the first three years and begins his professional studies, payments from home cease and the cadets are then no longer in any way dependent upon their parents or guardians.

Japan's navy is about forty years old. She then had one or two vessels. She realized immediately the necessity of training a corps of officers and sent young men to England and this country. The first Japanese midshipman entered Annapolis in 1869. One of her admirals, Uriu, in command of the squadron which fought the action off Chemulpo in February, graduated from Annapolis in 1881.

The Japanese Naval Academy is at Etajima, an island in the Inland sea, about ten miles from the naval port of Kure. It was founded about 1870.

Entrance examinations are strictly competitive and

open to all male subjects between the ages of 15 and 20, excepting those married, those who have undergone any serious punishment, and bankrupts. Every year the secretary of the navy publishes the names of the cities where the examinations will be held and gives the general character of such examinations. Last year 1,995 cadets presented themselves and 180 entered the academy. The number entering each year varies, but is about 200. The course is three years, each year commencing with the 10th of January and ending with the 9th of next January. The summer vacation is from July 21st to September 10th, and the winter vacation from December 21 to January 9. Examinations are held monthly, semi-annually and annually. Cadets are not marked on their daily recitations, but their examination marks fix their standing. To be satisfactory, cadets must make an average of 50 per cent. in all general branches and 50 per cent. in each technical branch. The course of instruction resembles that in Annapolis in a general way, professional subjects being taken up from the start. There are three training ships and five launches attached to the academy, and part of the vacation is devoted to drilling on board the ships. When the cadets have passed the final examination, they are promoted to midshipmen. They are then transferred to a training squadron of three modern cruisers commanded by a rear admiral. This squadron cruises for eight months in home and foreign waters, and its officers are generally composed of those who were instructors at the academy. During this cruise, the admiral transfers his flag several times so as to teach the midshipmen the duties on flag ships. After this cruise the midshipmen are distributed to the vessels of the regular fleet as sub-lieutenants, and perform the duties of junior officers, being closely watched by the captain and put under the charge of a very competent officer for particular instruction. The entire cost of maintenance of the cadets while at the academy is borne by the government.

It is worth while to give a translation of three rules taken from the academy regulations: "The education shall aim to develop cadets morally, physically, and intellectually; of the moral education, special attention shall be given to the encouragement of firmness and resoluteness. The object of moral education is to inculcate, in accordance with the Imperial Rescript and the natural character of Japan, a spirit of loyalty and love of country. To infuse this spirit, the instructors shall themselves be examples to the cadets, and frequently give the cadets illustrations from ancient and modern history. The object of physical education is to form vigorous officers able to perform the hardest tasks of naval service. For this purpose attention shall be paid to health, and encouragement shall be given to active exercises."

Japan's War Expenses.—The Japanese government estimates the expenses of conducting the war for the fiscal year 1904-1905 at about $284,000,000. The legislature has already provided for this outlay by passing acts for the issue of an internal loan amounting to $191,240,000, and of $15,438,000 in treasury orders. The balance will be raised by increased taxation.—*Richard Guenther, Consul-General, Frankfort, Germany.*

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of September 10, 1904, the following degree of completion of vessels building for the United States Navy:

			Degree of Completion. Per Cent.	
BATTLESHIPS.			Aug. 1	Sept. 1
Ohio	18 knots.	Union Iron Works	97	99
Virginia	19 "	Newport News Co	63.7	66.8
Nebraska	19 "	Moran Brothers Co.	54.3	56.7
Georgia	19 "	Bath Iron Works	59.3	63.3
New Jersey	19 "	Fore River S. and E. Co	63.8	66.4
Rhode Island	19 "	Fore River S. and E. Co.	66.1	68.9
Connecticut	18 "	Navy Yard, New York, N. Y.	47.3	50
Louisiana	18 "	Newport News Co.	52.59	56.5
Vermont	18 "	Fore River S. and E. Co.	13.4	16.3
Kansas	18 "	New York Shipbuilding Co.	17.7	22.1
Minnesota	18 "	Newport News Co	37.56	39.77
Mississippi	17 "	Wm. Cramp and Sons	6.65	7.71
Idaho	17 "	Wm. Cramp and Sons	6.50	7.47
ARMORED CRUISERS.				
Pennsylvania	22 knots.	William Cramp and Sons	84.2	86.7
West Virginia	22 "	Newport News Co.	89.32	91.62
California	22 "	Union Iron Works	62	63
Colorado	22 "	William Cramp and Sons	89.2	91.2
Maryland	22 "	Newport News Co.	86.87	89.16
South Dakota	22 "	Union Iron Works	59	61
Tennessee	22 "	William Cramp and Sons	42.45	45.74
Washington	22 "	New York S. B. Co.	38	41.4
PROTECTED CRUISERS.				
Chattanooga	16½ kts.	Lewis Nixon	91.9	94.62
Galveston	16½ "	Wm. R. Trigg Co	87	89
St. Louis	22 "	Neafie and Levy Co.	44.6	48.8
Milwaukee	22 "	Union Iron Works	54	57
Charleston	22 "	Newport News Co.	79.5	81.4
GUNBOATS.				
Dubuque	12 knots.	Gas Engine and Power Co.	52.7	58.4
Paducah	12 "	Gas Engine and Power Co.	45.2	53.6
TRAINING SHIPS.				
Cumberland	Sails	Navy Yard, Boston	57	66
Intrepid	"	Navy Yard, Mare Island	43.4	49.1
TRAINING BRIG.				
Boxer	Sails	Navy Yard, Portsmouth	65	75
TORPEDO BOATS.				
Stringham	30 knots.	Harlan and Hollingsworth	99	99
Goldsborough	30 "	Wolff and Zwicker	99	99
Blakely	26 "	George Lawley and Son	99	99
Nicholson	26 "	Lewis Nixon	99	99
O'Brien	26 "	Lewis Nixon	98	98

Wireless Telegraphy.—A message was recently sent from Chicago to St. Louis exposition, a distance of over 300 miles, by the De Forest wireless telegraph system. Heretofore the overland record has been 107 miles. This feat proves that by the De Forest system messages are not interfered with passing over cities where buildings and electric power houses intervene.

Coaling of War Ships.—*Page's Magazine,* of August, gives a description of the Mackrow and Cameron patent arrangement for rapid transporting of coal and other stores from a collier or transport to war ships at sea or at anchor. It essentially consists of an endless cable extending between the stern of the war ship and the bow of the collier. This cable is supported on the collier at the top of a cylindrical tube 5 or 6 feet diameter in which is located the driving and other mechanism. The loaded bags are attached to the outgoing cable and carried to the war ships and the empty ones return on the incoming line.

LAUNCH OF BATTLESHIPS CONNECTICUT AND LOUISIANA.

One of the most conspicuous launches which has taken place in this country occurred on September 29, at the Brooklyn Navy Yard, when the battleship *Connecticut* successfully slid down the ways. The ship was christened by Miss Alice Wells, granddaughter of Gideon Wells, who was secretary of the navy under President Lincoln. While the Brooklyn Navy Yard has been a busy place since the re-habilitation of the navy, practically all of the work has been confined to repairs. It will be remembered that it was from this yard that the ill-fated *Maine* was launched fourteen years ago, and since then to the present day no modern war ship has been constructed there. In the act of congress dated July 1, 1902, authorizing the building of two battleships, the secretary was instructed to build, if possible, one of the ships in a government yard. This was done for the

UNITED STATES BATTLESHIP LOUISIANA, LAUNCHED AT NEWPORT NEWS, AUGUST 27.

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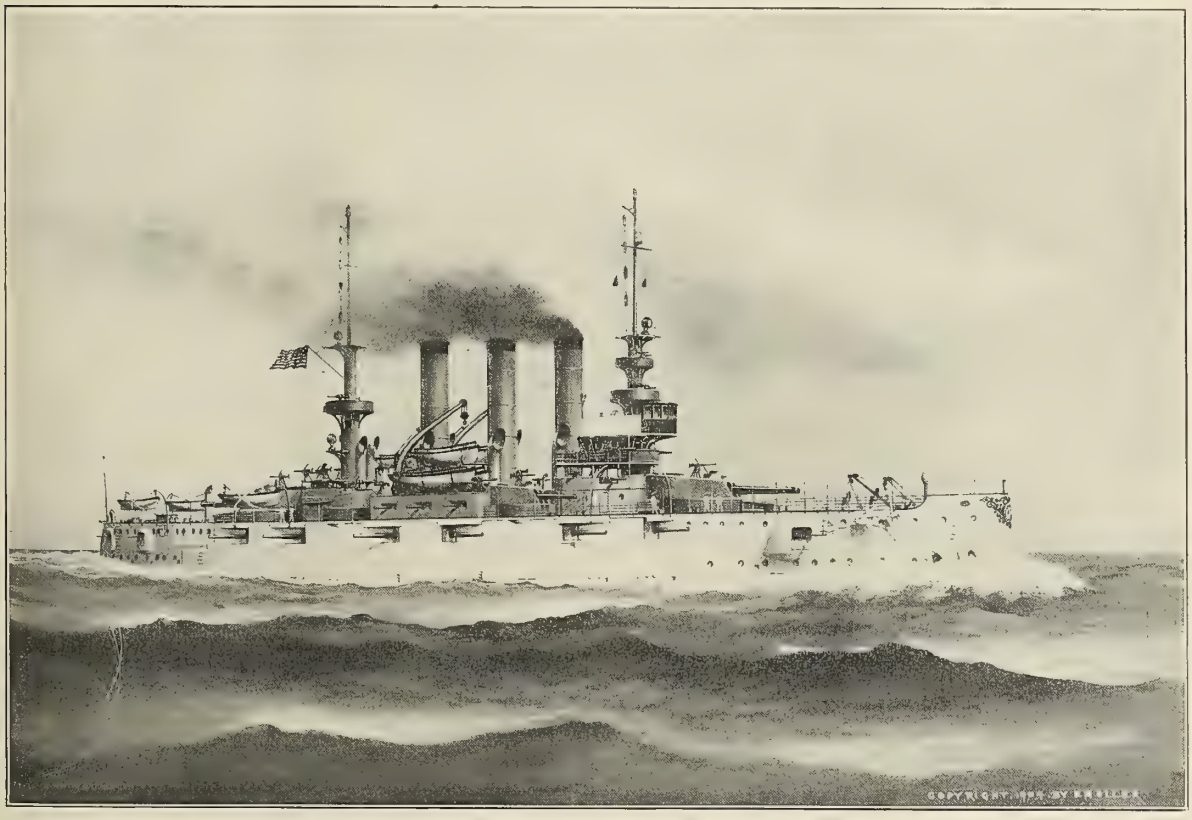
double purpose of finding out, first, if the government could construct vessels as cheaply as a private company, and to, in a measure, spur the private builders on to more rapid construction, as the vessels then under contract were many months behind in degree of completion. These facts have already been mentioned in these columns. The *Connecticut's* keel was laid in the Brooklyn Navy Yard on March 10, 1903, and the keel of her sister ship, the *Louisiana,* contracted for by the Newport News Shipbuilding and Dry-Dock Company, was laid on February 7 of the same year. Congress provided that the limit of cost for hull and machinery of the *Connecticut* should be $4,212,000, while the contract price for hull and machinery of the *Louisiana* was $3,990,000. There were, at the outset, many obstacles met with in the navy yard for rapid construction, and in the first months the work on the *Louisiana* was considerably in advance of that on the *Connecticut;* of late, however, the government has made greater progress, and in the last report, on September 1, of the Bureau of Construction and Repair, the *Connecticut* is credited with 50 per cent. completed and the *Louisiana* 56.5 per cent. From present indications it is probable that both will be completed before the contract date, which is March 15, 1906, and probably before many of the battleships authorized one and two years previously. The *Louisiana* was launched at Newport News, Va., on August 27.

These sister ships are identical in all particulars, except in some minor details, and are of as large tonnage as any battleship afloat. The principal dimensions are:

Length on load water line	450 ft.
Beam, extreme	76 ft. 8 ins.
Draft, normal	24 ft. 6 ins.
Displacement, normal	16,000
Indicated horse power	16,500
Speed	18 knots
Complement of officers	41
Complement seamen, marines, etc.	778

There will be a complete armor belt 9 feet 3 inches wide amidships, stepped down at the ends. In the wake of machinery space this belt is 11 inches thick at the top, tapering to 9 inches at the bottom. Forward and aft the armor is decreased in thickness to 9 inches at the top and 7 inches at the bottom, next 7 inches at the top and 5 inches at the bottom, then to 5 inches constant thickness, and finally 4 inches at the extreme ends. The casemate armor is 6 inches at the bottom and 7 inches thick at the top above the gun deck. The turrets for the 12-inch guns are 12 inches thick on the port plates, 8 inches on the side and back. These turrets rest in barbettes of 10-inch armor. The 8-inch guns are mounted in turrets 6 1-2 inches thick on the port plates and 6 inches thick on the sides and back.



UNITED STATES FIRST-CLASS, SEA-GOING BATTLESHIPS CONNECTICUT AND LOUISIANA.

[Copyright, 1904, by E. Muller.]

The main battery will consist of four 12-inch breech-loading rifles mounted in two turrets, one forward and one aft; eight 8-inch breech-loading rifles mounted in four side turrets, and twelve 7-inch breech-loading rifles mounted on the gun deck. There will be a secondary battery of twenty 3-inch rapid-fire guns 50 calibers in length; twelve 3-pounder semi-automatic guns; six 1-

pounder automatic guns; two 1-pounder semi-automatic; two 3-pounder field pieces; two machine guns, .30 caliber, and six automatic guns of .30 caliber. There will also be four 21-inch submerged torpedo tubes.

The normal coal supply is 900 tons, which gives the ship a steaming radius at 10 knots of 5,275 nautical miles The full load draft is estimated to be 26 feet 9 1-4 inches, which corresponds to a displacement of 17,666 tons.

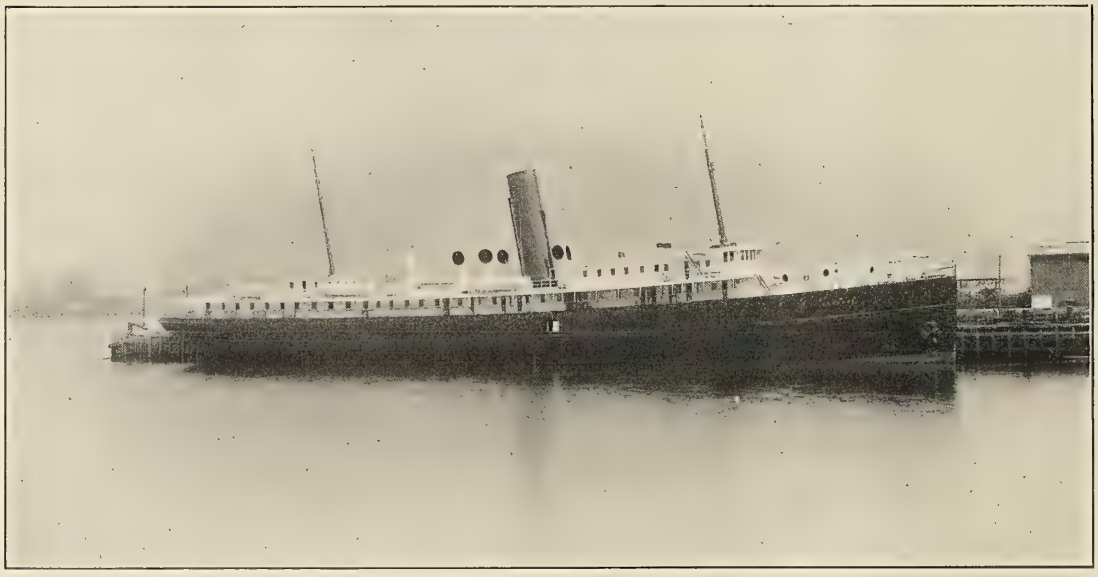
The machinery of each ship consists of two sets of vertical, triple-expansion, direct-connected engines, designed for 16,500 collective horse power at 120 revolutions per minute Each engine will be placed in a separate water-tight compartment and will have cylinders 32 1-2, 53, 61, and 61 inches diameter by 48 inches stroke. Steam at 265 pounds pressure will be supplied from twelve boilers of the Babcock & Wilcox marine type, placed in six water-tight compartments. The total grate surface of the boilers will be 1,100 square feet, and the total heating surface will be 52,750 square feet. There will be three funnels extending fore and aft. These engines, which are designed by the Bureau of Steam Engineering, were described and illustrated in Marine Engineering of April, 1903.

Queer Auto Motor.—In the London *Mail* there is given an account of interesting experiments conducted on the Seine by Count de Lambert, in conjunction with engine-builders De Dion and Bonton. The boat is termed a hydroplane and is 36 feet long and 9 feet wide. To the bottom of the boat are fitted five planes or fins, with axes thwartship, which hang vertically in still water; the planes are hinged and under control of the driver, and when the boat begins to move these planes are gradually given a backward angle; thus the boat gradually rises in the water and finally glides only on these planes when the maximum speed is reached.

New Steamship Ontario.

The latest coasting steamer, the *Ontario,* built by the New York Shipbuilding Company for the Merchants and Miners Transportation Company, recently went into commission on the Baltimore-Boston service. The ship is a single-screw, steel passenger and cargo steamer of the hurricane-deck type, 315 feet over all, 42 feet molded beam, 33 feet 2 inches deep, built according to the rules for coastwise vessels of the American Bureau of Shipping.

There are four complete decks—orlop, lower, main, and hurricane, and on the hurricane deck is a large deck house. The hold, orlop, and lower decks are exclusively for cargo. On the main deck forward are accommodations for firemen and crew, as well as two rooms containing berths for 18 second-class passengers. Immediately aft is a large space devoted to cargo. Abreast of the engine and boiler casings are the engineers' quarters, officers' mess room, galley, and ice room; aft of the engine casings is another large cargo space, and at the stern are the stewards' and waiters' quarters.



NEW COASTWISE STEAMER ONTARIO.

The hurricane-deck house is comfortably fitted up to accommodate first-class passengers. There is a large dining saloon tastefully finished in polished mahogany, pantry, toilet rooms, and 48 large state rooms. On the top of the hurricane-deck house, at the forward end, is the pilot house, captain's quarters, and the smoking room, the latter being finished in oak. At the after end is a small observation house, connected by stairs to the main saloon.

The ship is propelled by a triple-expansion engine of about 3,500 horse power, with cylinders 28, 45, and 72 inches diameter by 54 inches stroke. Steam at 185 pounds is supplied by two large double-end Scotch boilers, 15 feet diameter, 19 feet 6 3-8 inches long, fitted with forced draft. The total grate surface is 220 square feet, and the heating surface 9,720 square feet.

GAS PRODUCERS ON SHIPBOARD.

BY BERNHARD A. SINN.

In a previous article the author spoke of gas producers and gas engines as the most economical means of generating power known on the land to-day, and it does not seem improbable that in the very near future use will be made for marine purposes of principles that have lately proved so successful on land. Several manufacturers of gas and gasoline engines are to-day manufacturing machines of large power that are reversible and of high thermodynamic efficiency, and it only remains to take advantage of the gas producer to bring the same into competition with soft coal steam machines. Mr. Thornycroft, in a paper read before the Institute of Naval Architects, says: "The gas engine has hardly yet been tried for marine purposes; but, owing to the recent great improvement in gas producers, it is thought they will be used extensively."* This has lead the author to the preparation of this article in the hopes that it will prove of interest to marine engineers, and perhaps induce progressive ship owners to make a trial of this class of machinery.

Let us say a few words relative to the suction-gas producer. Its chemistry is no different from that of other gas producers, and the mechanical means employed for making gas is the same as has been used for many years on land in the production of power gas. The fact that the gas engine requires a suction stroke for drawing the gases into its cylinder has been taken advantage of in drawing the air and steam through the gas producer. This has lead to the adoption of this type of machine.

The gas producer consists primarily of a shell lined with refractory material having a sufficiently deep bed of coal to completely transform the oxygen from the air and steam into carbon monoxide, at the same time carrying with it in the form of free hydrogen and oxygen such portions of the dissociated steam other than the oxygen necessary for combustion. We have, therefore, as the constituents of producer gas, carbon monoxide CO, hydro-carbons C_2H_6, hydrogen H, and nitrogen N, and due to incomplete gasification carbon dioxide CO_2, and free oxygen O. These elements and combinations produce a gas which has a heating value of approximately 140 B. T. U. per cubic foot and will generate a brake horse power on 80 to 85 cubic feet of this gas, in a producer gas engine. The gases, after having been formed in the generator, are of such high temperature that they must be materially cooled before being used. This is done without effecting the internal heat of the gas in any degree whatsoever, the only losses being those due to radiation in the generator itself and heat carried off in the cooling water. These combined sources do not amount to more than 12 to 14 per cent. in producers of good type, well designed.

The heat which must necessarily be removed from the gases in cooling is utilized in doing useful work in two ways—to generate the necessary steam and to heat the incoming air.

The steam is used to enrich the gas in place of using oil or other external means, as the proportion of heat-giving elements in the gas must be increased as much as possible, thereby decreasing the ratio of those that are dead for purposes of generating power. Air only contains one-fourth as much oxygen, the heat-giving component, as nitrogen, the inactive element, and in order to secure sufficient oxygen for gas making it is necessary at the same time to add a large volume of the nitrogen. If we were able to obtain free oxygen without using air (or using energy in manufacturing oxygen) we could get a very rich gas. Therefore, the only available method of obtaining the necessary oxygen is either from the air or by disintegrating steam. The latter is accomplished by passing steam through a bed of live carbon; but this requires heat; therefore it is necessary to have both air and steam for such oxygen as we need to keep the fires alive. In this way the proportion of the free nitrogen in the gas is reduced from 80 to 55 per cent., and the gas is enriched from 100 thermal units per cubic foot to 140. The amount of steam that may be added depends upon the heat in the generator; the hotter the generator the more steam can be successfully used and the richer will be the gas.

Before utilizing this gas certain impurities in it must be removed. These impurities depend upon the nature of the fuel employed, and would amount to nothing if pure carbon were used. In charcoal they consist of traces of ammonia and sulphur; with coke as fuel, there would be present traces of tar, ammonia, and sulphur; with one ton of anthracite coal, we would have to remove 1 to 2 pounds of ammonia gas, perhaps 1-4 to 1-2 per cent. of tar, and some sulphur; with soft coal, all the tar in the coal itself, varying from 10 to 12 gallons per ton and even more, and 4 to 5 pounds of ammonia gas and sulphur, depending upon the mines from which the coal comes, would have to be extracted.

The apparatus necessary for removing these impurities consists of a washer, wherein by means of ammonia-water the tar is washed out of the gas, the gases being cooled to such a point that tar will deposit; a scrubber, wherein the gases are washed free of ammonia by means of running water passing over porous material of various sorts; a purifier, wherein the sulphur is removed; and, finally, the gases must then be screened of all solid matter.

This will give a general idea of the character of the apparatus necessary for the production of gas. A gas holder is necessary where gas is stored or produced by a blast method, but this method is being supplanted by suction apparatus wherein the gases instead of being blown through the producer and cleaning devices are sucked through the same either by the engine itself or by means of an exhauster. This has a two-fold advantage—it produces a gas as it is used, and instead of putting a gas producer under pressure it is constantly under a slight vacuum which obviates any danger of leaks and consequent explosions; gas cannot leak out of the generator, for if there be any unsealed openings air will enter the machine.

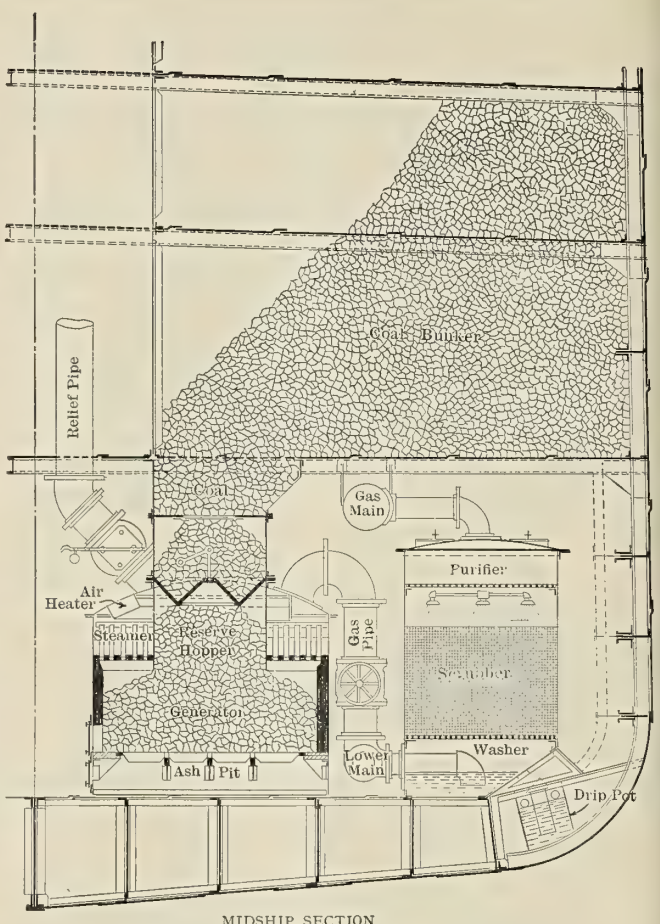
In this article a gas-producing plant of 10,000 indicated horse power is shown if placed on ship board. In good land practice to-day an indicated horse power per hour can be obtained on 70 cubic feet of producer gas; this would mean that there must be a generator capable of producing 700,000 cubic feet of gas per hour. As 90

*See Marine Engineering, May, 1904.

cubic feet of gas can easily be made from one pound of coal, the generator would be required to burn 7,800 pounds of coal per hour. This is divided into four units, which means approximately 7-8 tons of coal would have to be burned per hour in each. With a steam boiler under light forced draft, a consumption of 20 pounds of coal per square foot under normal conditions is good practice; the generator will require approximately the same percentage of grate surface as is necessary in a steam boiler, consequently 97 1-2 square feet of grate would be required in each generator, which would mean a diameter of 11 feet 5 inches; this determines the inside diameter of the generator. The depth of the fuel bed should be not less than 24 inches at its lowest place; this readily determines the height of the generator.

On top of generator is built what is to all intents and purposes a boiler. The gases from the fire pass through tubes, heating the water and forming steam, and at the same time are cooled off. They now pass around a further series of heating tubes through which the entering air passes, and are then piped to the washer. An automatic arrangement is fitted to the boiler whereby the water level is maintained, and as the required steam is of practically no pressure, this is very easily accomplished. Sight cocks are placed at various points in the generator shell so that the condition of the fire may be constantly observed. Where soft coal is used a special steam jet arrangement is installed on the inside of the generator to break up the clinker and permit of proper running. Air-tight and easily opened cleaning doors are necessary in the generator, which must also be provided with a large ash pit. There should be no possible chance of leakage anywhere in the machine, and for that reason all joints are made tight by gaskets or by calking. In this connection we might say that a blower is necessary for starting the fire, and after the producer is once in operation this is entirely dispensed with. During the preliminary period of starting, while the blower is in operation, a slight pressure will exist in the generator, but at no other time.

The charging arrangement is very simple. It consists of a bell at top of generator similar to that used in blast furnaces, which is kept in a raised position when the generator is operating and no coal is being charged; when it is necessary to add coal the bell is dropped, the coal slides into the generator, and the bell then again is raised to its original air-tight position. Above this is a slide which is opened, permitting the coal to fall into the charging hopper, then closed again so none of the gases will escape into the coal bunker while the generator is being charged. The bunker may be advantageously placed right above the generator room, as shown in the drawing, whereby the coal will require no trimming, as sufficient will fall into the hopper of itself, except when coal from the reserve bunker is required. This does away with firemen, passers, and trimmers, except a small crew, whose sole duty, under ordinary circumstances, would be removing the ashes and cleaning up. A relief pipe to the stack is necessary from each generator. This is only used when the engine is not running and should, for any reason, a pressure of gas arise in the generator. This relief should be set to 1-4 or 1-2 pound and will act as a safety valve.

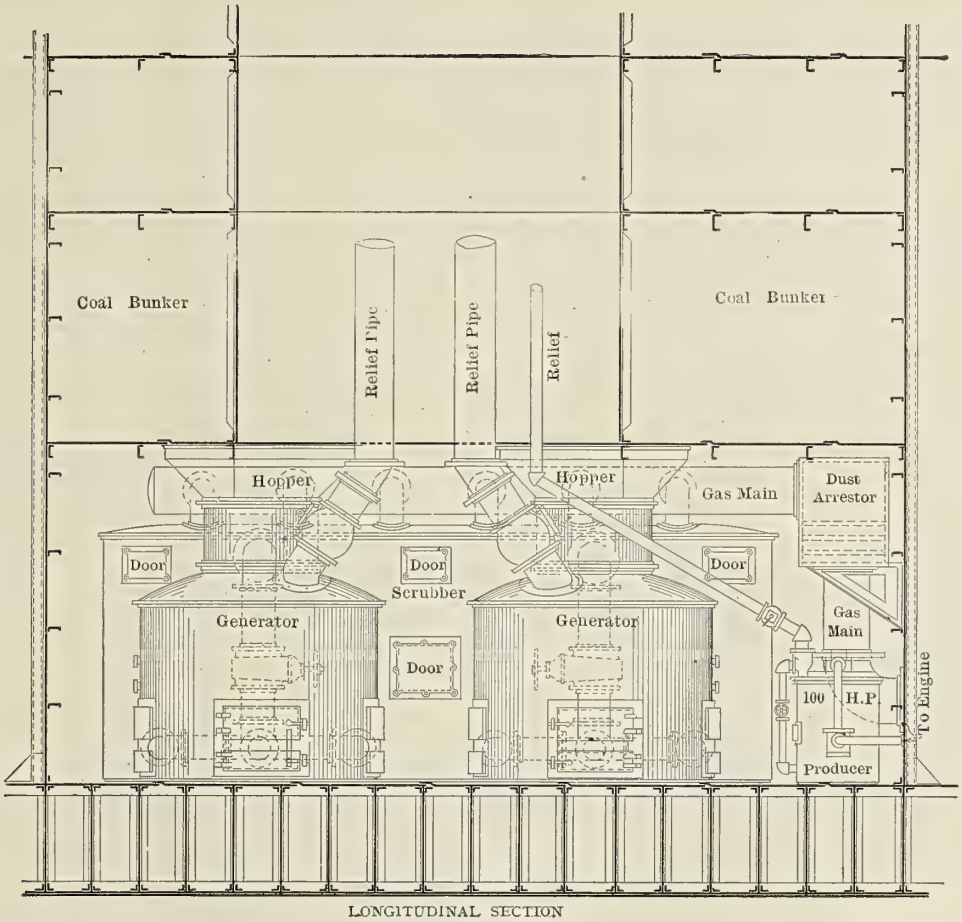


MIDSHIP SECTION

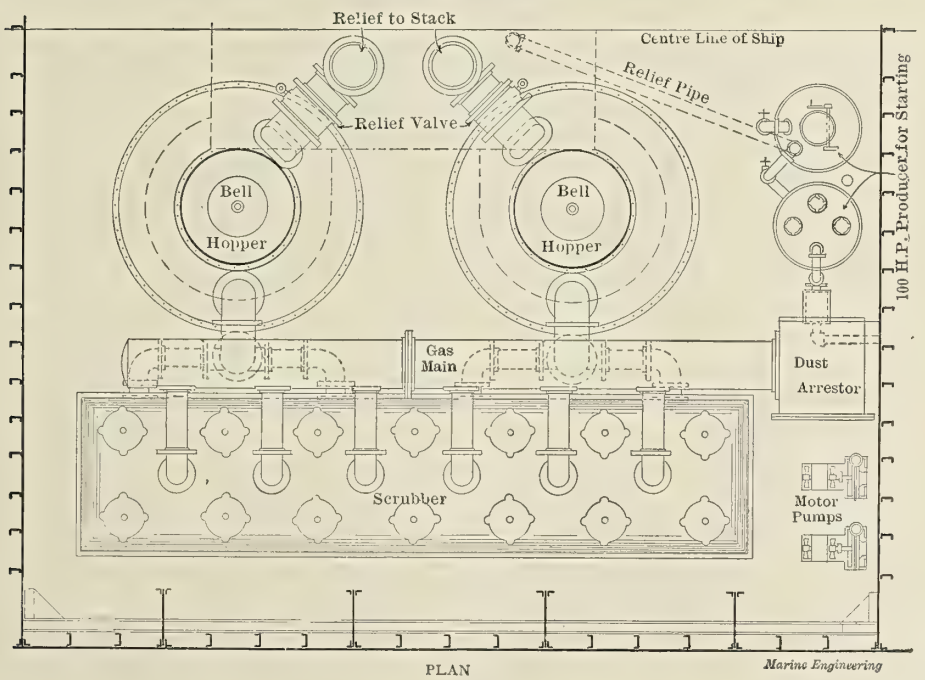
10,000-HORSE-POWER GAS-PRODUCER PLANT ON SHIPBOARD.

The cleaning device, embodying washer, scrubber, and purifier, consists of a rectangular shell which contains a series of wooden grids or masses of charcoal or limestone over which water is sprayed. The gases from the generator enter at the bottom of the washer through pipes submerged in water, and in rising to the outlets at the top are broken up by these masses and come in contact with the large water covered surface. This cleans the gases of ammonia. The ammonia water in turn removes such tar as may be in the gas and is then drained into wells and pumped overboard. In order to break the gases up to a greater extent, in a large plant of this sort the inlet is through a series of pipes at the bottom and the outlet at the top is also through several lines into one large gas main pipe.

Before the gases pass to the dust arrester they are sent through wood shavings, or mineral wood, where they are dried of moisture and relieved of sulphur. This is the only portion of the apparatus that requires cleaning, the shavings having to be removed probably every two months. The dust arrester, consisting of a series of screens of wire gauze and cotton gauze, serves at the same time as a flame arrester should there be any back explosion from the engine. The gases are now ready for delivery to the engine, and that portion relating to the engine room will be described in another article.



LONGITUDINAL SECTION



PLAN

ARRANGEMENT OF ONE-HALF A 10,000-HORSE-POWER GAS-PRODUCER PLANT ON SHIPBOARD.

Let us now examine the method of operation. There should be two starting machines, started by hand, as are shown on the plan, in all respects similar to the large machine. As soon as a sufficient quantity of gas is generated in the small machine to show at the test cock, it is used to operate a gas engine direct connected to dynamo. The electricity from this source charges a storage battery and from there is distributed throughout the ship. Some of this power is required for the pumps and starting blowers of the main plant. The main generators are now filled, a wood fire being built just as would be customary in a boiler, and the coal gradually added and brought to an incandescent state. The blowers are kept working only until such time as the fuel bed shows that the gas is ripe and steam shows in the boiler. The main engine may now be started as follows: close the relief pipe; shut off all sources of air to the generator, start the main exhauster if the gases are sent to the main engines through exhausters, and allow the gases to pass through the scrubber to the engine. The exhauster is in the engine room and forms part of the engine equipment, although spoken of in connection with the generator. Now open the hot air pipes and regulate the steam supply and the gas is ready to supply the engine.

Such gas as is necessary for the auxiliary machines is taken from the main gas pipe, the exhauster being regulated so that there is not more than a vacuum of 8 inches of water in the main at any time; above this pressure the exhauster rotates free and sucks no gas. The auxiliary machines are now all operating—the refrigerating plant, if there is one aboard; electric plant, sanitary, bilge, circulating pumps, fresh water, hot and cold pumps, and all the gear that is customary in the engine room of a steamer.

When the vessel arrives at the end of the trip one, two, or three of the generators are allowed to exhaust through the relief; the fourth is necessary to give heat to the saloons, run the winches, etc., and is therefore kept in blast. Ten minutes before the steamer is ready to depart, the fires which have been kept clean are brought up, and we are once again ready to start. Should anything happen to one or two of the generators the remaining machines can be easily forced to double their capacity, requiring only greater frequency in filling.

Three-quarters pound of coal per I. H. P. has been obtained in land practice with comparatively small plants, and there is no reason why the same results should not be obtained in marine work. This would mean a saving of 100 tons of coal per day in a 10,000-H. P. plant; it would mean 40 men less in the fire room; it would mean a saving of 1,500 tons in weight in machinery and coal required, giving the vessel so much more carrying capacity, and all this translated into dollars and cents, would readily show a net saving of $150,000 to $250,000 annually. This is on no greater first cost than a steam plant, and on a boat of the *Minneapolis* type, of the Atlantic Transport line, would permit a saving of twelve frame spaces in the length of boiler room. These considerations indicate that if investigation along this line be carried on at an early date, it will result advantageously to both the engineer and the ship owner.

Shipbuilding Plants Sold.

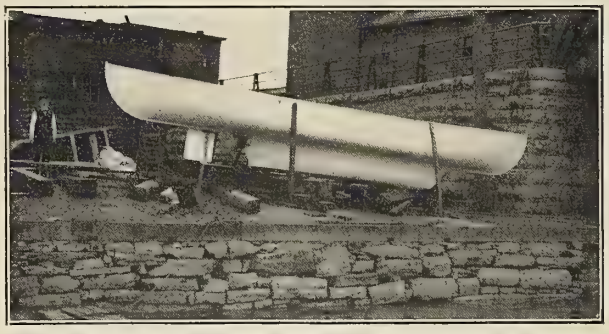
According to the plans of the reorganization committee of the United States Shipbuilding Company, the properties of that defunct corporation were sold in September as per the following schedules and for the upset price set upon the properties by the receiver. In each case the properties were bought in by a representative of the reorganization committee.

Crescent Shipyard, real estate $125,000, personal property $25,000; Samuel W. Moore & Company, real estate $175,000, personal property $30,000; Canda Manufacturing Company, $200,000; Eastern Shipbuilding Company, real estate $125,000, personal property $20,000; Hyde Windlass Company, real property $125,000, personal property $100,000; Bath Iron Works, real property $300,000, personal property $40,000.

The date set for the sale of the Union Iron Works is September 26, and it is understood that the Harlan & Hollingsworth plant, at Wilmington, will be disposed of early in October. After all the properties have been bought in it is stated that the stock of the concerns will be conveyed to a corporation to be known as the Bethlehem Steel and Shipbuilding Company.

On September 7 the property of the Fore River Ship and Engine Company was bought at foreclosure sale by the Fore River Shipbuilding Company. The new company has had cash amounting to $1,250,000 paid in and will carry on the business and assume the contracts of the company which it succeeds.

At public auction a representative of the bond holders of the Marine Construction and Dry-Dock Company bought in the property of said corporation. The reorganized company will resume work at once.



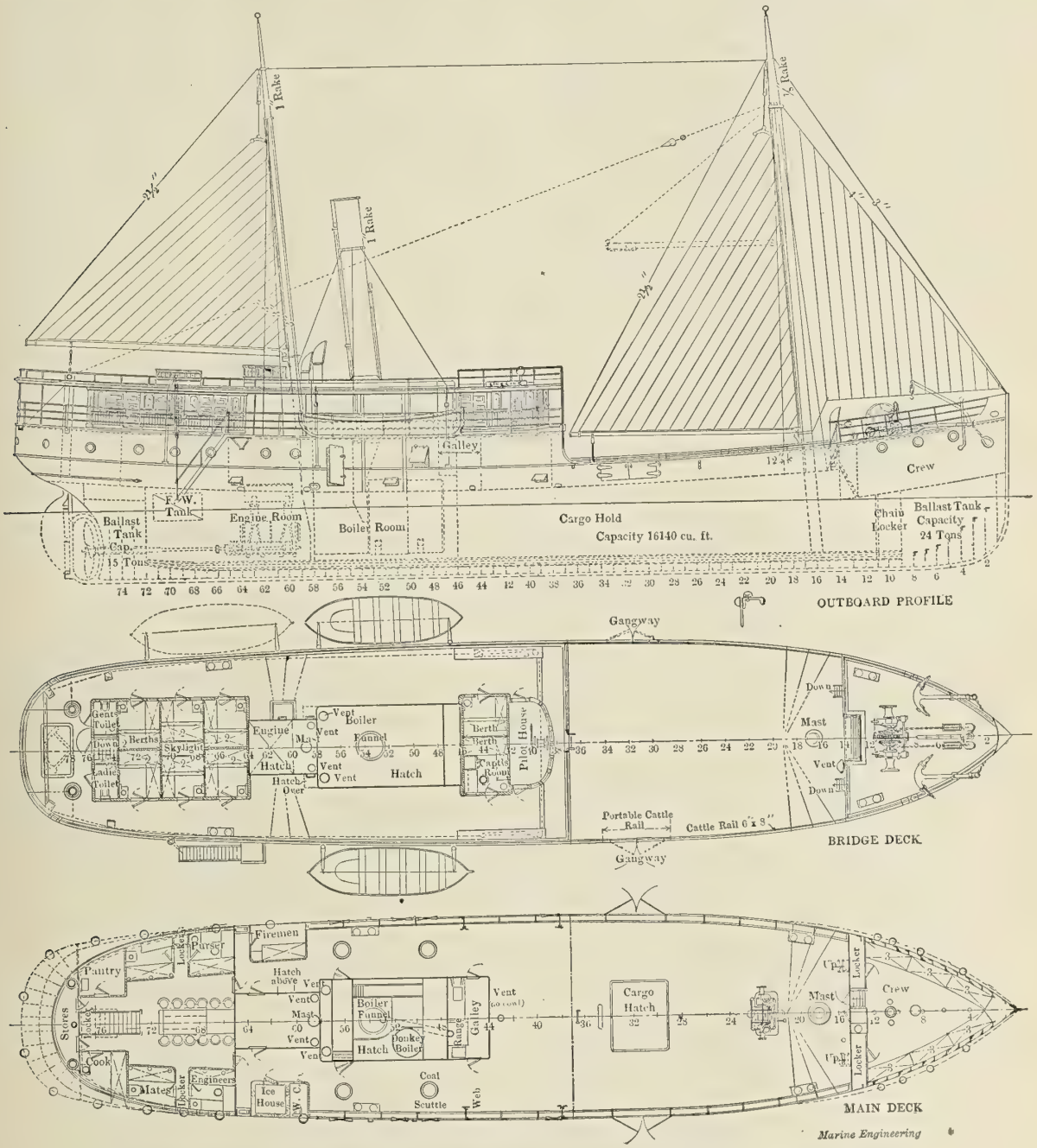
New Type of Hull.—A working model of a new design of boat has recently been completed at Buffalo, N. Y., by Capt. Samuel Golden. The hull itself resembles that of a shallow boat, while to the bottom of it is attached what is called a hull fin, in which is placed the engine. Placing the weight of machinery so far below the center of buoyancy gives the craft large stability it is claimed. The manœuvering qualities are stated to be exceptionally good, as screw and rudder are not far aft of amidships.

New Mining Publication.—The *Mining Magazine*, an international monthly review of current progress in mining and metallurgy, and an outgrowth of the *Pacific Coast Miner*, is the latest arrival in the field of mechanical journals. That it will be strong editorially and a success commercially is assured from the fact that it is published by Mr. W. J. Johnston. The publication office is at 120 Liberty street, New York.

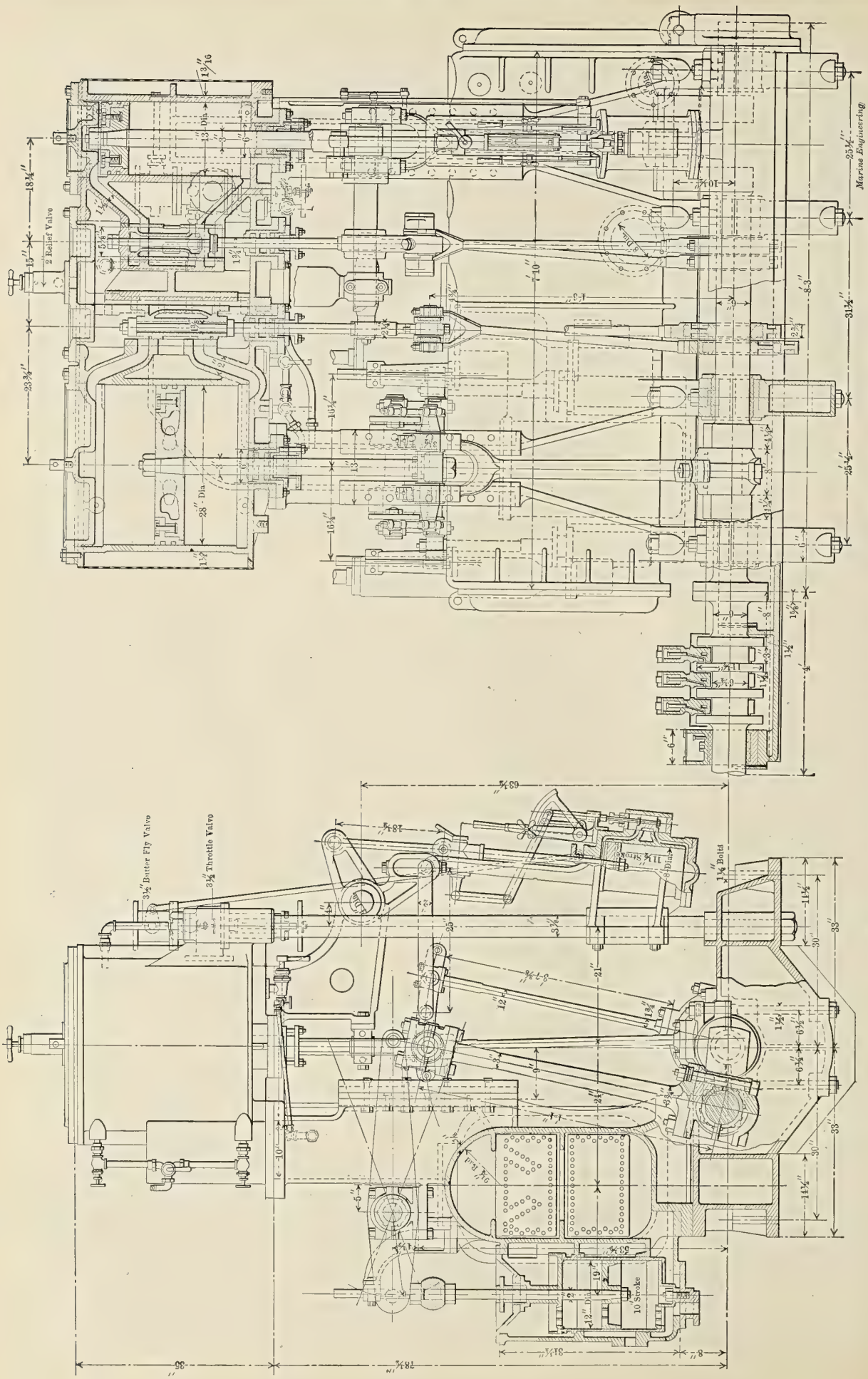
PACIFIC COAST STEAM SCHOONER LIKELIKE.

The steamer *Likelike,* recently completed by the Union Iron Works, San Francisco, Cal., is of the Pacific steam-schooner type, with straight stem, eliptical stern, two-pole masts with cargo gaff on foremast, and triangular sails. She is the fourth vessel turned out by this yard for the inter-island trade of the Wilder Steamship Company of Honolulu. Her hull is of steel throughout and classed I-3/3 by Bureau Veritas. The construction throughout is up to the standard maintained by this yard, and is well shown on the midship section on page 459.

The bar keel and stem are of best quality of forged scrap iron both of 6 by 1 5-8 inches section. The stern frame is of the same material, 6 by 3 1-2 inches, with gudgeons forged solid with frame, steel pintles with brass liners. The center keelson is made up of a continuous vertical plate 11 by 7-16 inches, running on top of floors; the foundation plate 12 by 5-16 inches, and rider plate 8 by 7-16 inches. The angles, both top and bottom, are 3 1-2 by 3 1-2 by 5-16 inches. The frames are 3 1-2 by 3 by 5-16 inches for 1-2 length reduced in thickness to 9-32 inch at ends, while the reverse bars are



LONGITUDINAL AND DECK PLANS OF THE STEEL, STEAM SCHOONER LIKELIKE FOR THE PACIFIC COAST.



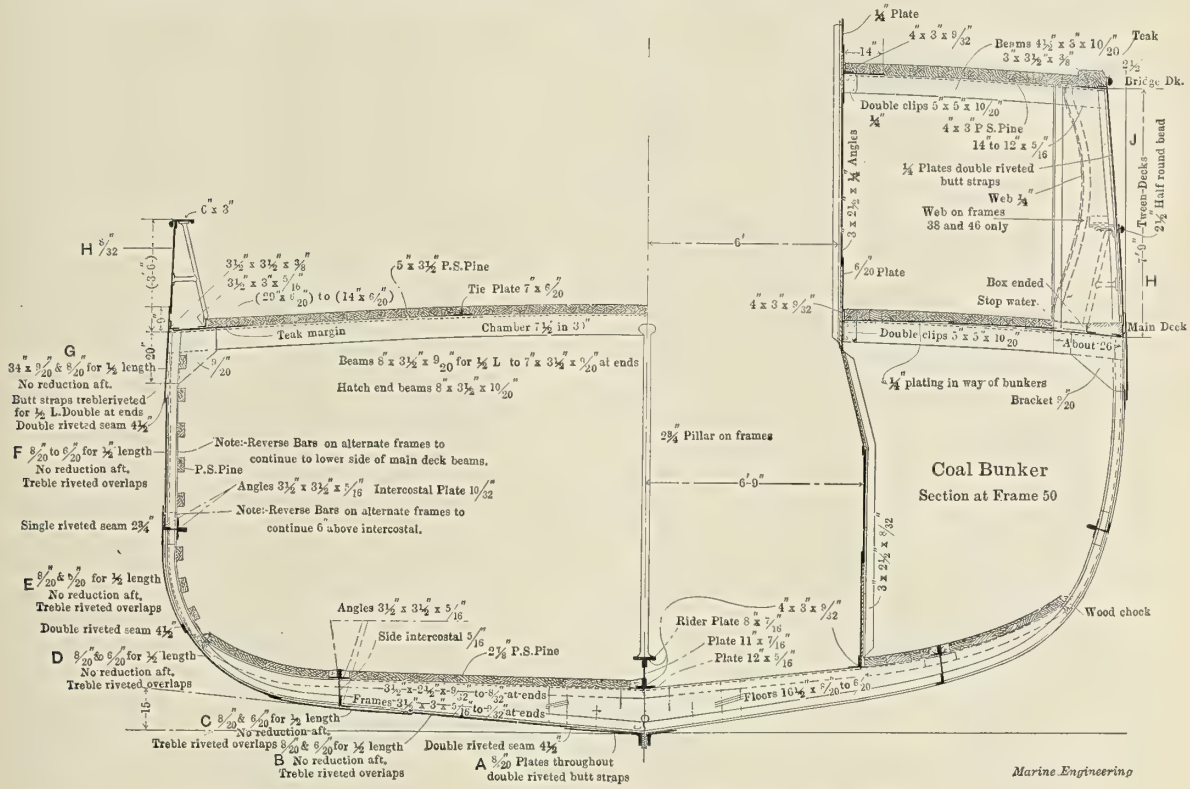
COMPOUND SURFACE CONDENSING ENGINE OF THE PACIFIC COAST SCHOONER LIKELIKE.

3 by 2 1-2 by 9-32 inches reduced to 8-32 inch. Other details of the scantlings, as well as the method of construction, will be found by referring to the drawing of midship section.

The main hatch combings 12-32 inch, standing 27 inches above the deck beams, have bead at top and stop for wood covers. Wood covers 2 3-4 inches thick made in 24 inches widths. Coaming plates extend 4 inches clear below the beams and carlins and are turned to 4 inches radius. Hatch fitted complete with tarpaulin battens, cleats, strong backs, ring plates, etc. Doubling plates are worked on shell plating in way of main hatch. The deck house and shade deck are built of wood and men's quarters. The main cabin is aft and has seats at table for 12 people. The rooms opening into it are for the engineer, purser, mates, steward, and cook.

Abreast the boiler room are 4 coaling scuttles, two in each side. In the pilot house is the necessary equipment and the hand-steering wheel, the gear being laid aft on the top of bridge deck. The captain's room and state room are in same deck house with pilot house. The house aft contains 6 state rooms opening onto deck, and the necessary toilet rooms.

Forecastle air ports are 9 inches diameter, other ports 12 inches; forecastle and poop rail of solid iron rods 1 1-4 inches for lower, 7-8 inch for upper, carried by



MIDSHIP SECTION OF THE LIKELIKE, BUILT BY THE UNION IRON WORKS.

Venetian doors are fitted to all state rooms in addition to regular doors.

ARRANGEMENT.

The fore peak has a capacity of 24 tons for ballast; directly aft is the chain locker, and from this to frame 46 is the cargo hold, with a capacity of 16,140 cubic feet. The forward boiler-room bulkhead is water-tight. Wing coal bunkers, with a total capacity of 31 tons, extend on each side of boiler room, and directly aft is the engine room. A large fresh-water tank of 2,380 gallons is under the engine, and the after-peak tank has a capacity of 15 tons for ballast.

The forecastle drops 4 feet 6 inches below the main deck and has accommodation for 18 men. Very little wood work is used. A galley of sufficient size to cook for 40 men is at the forward end of boiler-room enclosure; in the starboard side, opposite the engine hatch, is a large ice house, and on the port side are the fire-solid iron stanchions. On poop deck alternate stanchions are carried to shade deck. A double cylinder, geared, friction windlass, for 1 3-8-inch stud link chain, having heavy gypsy heads for handling lines, is fitted on the forecastle. There are three anchors, two of 1,344 pounds and one of 1,176 pounds, 180 fathoms of 1 3-8-inch stud link chain, with ends shackled together. Anchor davit is 5 1-2 inches diameter, 8 feet reach.,

There are two surf boats, 24 feet long, fitted with air tanks at each end, on davits 4 1-2 inches diameter stepped on the outside, and long enough to lift the boat to the level of bridge deck, fitted with 10-inch blocks and 3 1-4-inch four-strand manila falls. There will be two hardwood boat skids for each boat fitted on the outside of vessel. An extra pair of davits to be fitted complete for spare boat.

The masts are of wood, well proportioned, fore mast stepped on the keelson and wedged at main deck; heel

20 inches diameter, partners 22 inches, hounds 16 inches, head 11 inches, pole 4 inches. The main mast stepped on strong beam, well stanchioned, and to wedge at poop deck; heel 18 inches, partners 19 inches, hounds 14 inches, head 9 inches, pole 4 inches. Partners consist of a 5 by 2 1-2-inch angle built well riveted to the deck. Jack stays are fitted on the after side of each mast and the booms fitted with goose necks. Cargo gaff slides on jack stay and has 2 sheaves on the outer end for cargo falls. There are two steel cargo span posts, one on each side of vessel, 6 feet from center and 11 inches aft of transom frame, stepped on the main deck and carried above the shade deck, 14 inches diameter and constructed of 7-16-inch plates doubled at the top. Just under the shade deck a heavy band will be fitted on each post with eyes to take 2 1-4-inch stay rods leading down aft and outboard to chain plates on poop deck and also for a stay rod between posts. A cavil of 3-inch solid-iron 32 inches long fitted through each post above shade deck for belaying the 8-inch manila cargo span.

The shrouds are set up with brass turn buckles, stays with iron sheaves. Fore shrouds 3 1-2 inches, fore stay 4 inches, fore-topmast stay 3 inches, main shrouds 3 inches, triatic stay 3 inches, all of galvanized wire rope. All running rigging manila, all blocks patent metaline, iron strapped, all sails of No. 1 canvas.

Scuppers 2 1-2 by 5 inches cut through sheer strake and deck bar at main deck and backing bar fitted under deck for one frame space; bridge and forecastle of 2-inch lead pipe.

A fire main of 2 1-2-inch galvanized iron pipe leads along main deck on port side with the required hydrants, and rises to upper decks, fitted to connect with steam and hand pumps. There is a manifold in engine room connected with the suction of the feed and bilge pump, with a 2 1-2-inch heavy lead pipe branch to machinery space, and to a manifold at forward fire room bulkhead from which a 2-inch heavy lead pipe leads to each end of fore hold. The after peak is drained by a cock on bulkhead and fore peak by a steam syphon.

A hand pump of 100 cubic inches capacity of chamber is fitted on main deck and connected with the sea, manifold, fire main, and auxiliary feed pipe. A fresh-water tank of 2,300 gallons' capacity, with all the necessary connections, is placed in the after end of engine room and thoroughly braced and secured.

MARINE ENGINEERING DATA CARD. OCTOBER, 1904.

NAME—Likelike. NATIONALITY—American. TYPE—Steam schooner.

LAUNCHED—Feb. 13, 1904. BUILDER—Union Iron Works. OWNERS—Wilder S. S. Co.

Length over all	144 ft. 0 ins.
" between perp.	136 " 0 "
Beam, molded	30 " 0 "
Depth to main deck	12 " 6 "
Draft, loaded	10 " 3 "
Displacement, loaded	706 tons
Dead weight capacity	397 "
Block coef.	.60
Immersed mid-ship section	280 sq. ft.
Bunker capacity	62 tons
Propeller,	solid; 4 blades
Diameter	8 ft. 3 ins.
Pitch	8 " 3 "
Area Helical	28 sq. ft.
Ratio of im. midship sect. to hel. area,	10 to 1
Engine, number of	1
Type	compound
Cylinder, diam	13 and 28 ins.
Stroke	15 "
Estimated revs. per min	133
" I. H. P.	300
" speed	10 knots
Condenser surface	460 sq. ft.
Boiler,	one Scotch; Nat. draft
Pressure	150 lbs.
Length	11 ft. 0 ins.
Diameter	10 " 10 "
Furnaces	2
Diam. of furnaces	40 ins.
No. of tubes, 3 ins. diam., 7 ft. 3 ins. long	166
G. S.	42 sq. ft.
H. S.	1,724 " "
H. S. ÷ G. S.	29.14
H. S. ÷ I. H. P.	4.08
I. H. P. ÷ G. S.	7.14

MACHINERY.

The main engines are of the fore-and-aft open-front type of 300 I. H. P. Cylinders are of hard cast iron without liners. The back framing is of cast iron with condenser shell extending the entire length of engine. The front of cylinder is supported by two wrought-iron columns. The shaft, connecting, and eccentric rods are of forged steel, the two latter with forked ends. The thrust bearing, carried by an extension bedplate, is of the horse shoe type and lined with white metal. The general arrangement and dimensions of the engine will be found in the drawing on page 458. The air pump is placed behind the condenser and driven by levers from the low-pressure crosshead, and at the side of the air pump are feed and bilge pumps driven from the air pump crosshead. An independent centrifugal pump, driven by a 5 by 5-inch engine circulates water through the condenser.

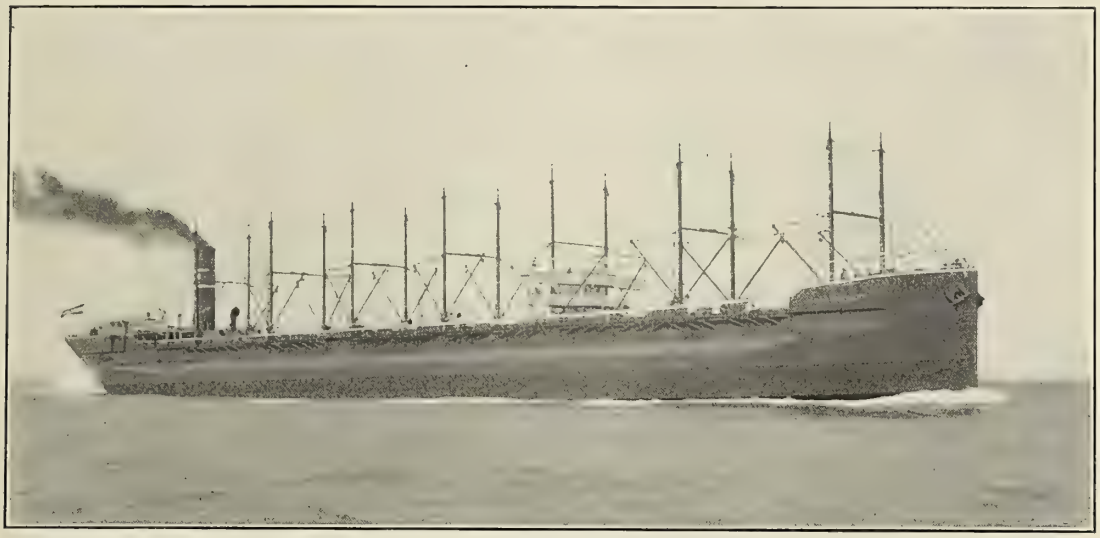
The boiler is of the Scotch type fitted with two Morison suspension furnaces with separate back connections and made for a working pressure of 150 pounds. The vertical donkey boiler, 48 inches in diameter, placed on the main deck, is designed for a pressure of 140 pounds. A straight lift steam ash hoist is placed on the screen bulkhead of boiler room for hoisting ashes through either ventilator. A copper-coil, feed-water heater is installed in the feed line. Necessary pumps for boiler, feed, fire, bilge, and other services are installed. An electric generator of 4 Kw. capacity direct connected to a 4 1-2 by 4 1-2-inch engine supplies current to sixty 16 c. p. incandescent lamps of 110 volts placed on the two-wire system.

Following is some of the launching data:

Date of launch, February 13, 1904.
Ground ways, 8 by 14 inches.
Sliding ways, 7 by 14 inches.
Inclination of ways, 1 inch in 15 1-2 feet.
Length of cradle, 82 feet.
Effective area of sliding ways, 178 square feet.
Weight of ship, 285 tons.
Weight per square foot, ways, 1.6 tons.
Distance traveled to point of maximum speed, 100 feet.
Time elapsed to maximum speed, 16 seconds.

Turret Ship Whateley Hall.

The launch of the *Whateley Hall* on June 16, 1904, by Messrs. Wm. Doxford & Sons, Ltd., Sunderland, the builders and patentees of the turret type, marks the hundredth steamer of this class built by this company within ten years. As might be expected, when the first turret steamer came out, so unusual was her construction that she met considerable adverse criticism, chief of which was that of Lloyd's Register. So successful have been these vessels from the owner's standpoint that they have come into quite general popularity, so that in the ten years mentioned the one hundred ships built have a total of about 550,000 tons of cargo carrying capacity and are valued at about $20,000,000. While these ships are suitable for carrying general cargo, they are claimed to be specially desirable as ore and coal carriers, and for bulk cargoes of light weight, as they are large measurement carriers. Some of these vessels have fine lines and run as high as 12 and 13 knots. Among the advantages claimed for turret steamers are:



COAL CARRYING TURRET STEAMER GRANGESBERG.

NEW TURRET STEAMER WHATELEY HALL.

Lower registered tonnage, in comparison both to deadweight and cubic capacity, thereby enabling these steamers to earn more freight on lower working cost.

Full cargoes of grain can be loaded in bulk from America and elsewhere, thus saving cost and loss of time in using bags, as is compulsory in ordinary cargo steamers, and in ships in the India trade saving canal dues, owing to their low tonnage, on which canal dues are chargeable.

UNITED STATES CRUISER COLUMBIA, NOW ASSIGNED TO THE TRAINING SQUADRON.

Their freeboard gives more than double the height from the water than that of the ordinary steamer, consequently their decks and hatches do not get damaged by the sea, and the crew are more comfortable.

In discarging ore, coal or timber, it is not necessary for the cargo to be carried from the hatch over a wide deck, but coal and ore can be tipped into a chute and run into lighters, and timber can be shot over the harbor deck into the water, thus saving in labor and time when discharging these caroges.

In loading coal, the trimming charges are lower than the ordinary type, the ships are more quickly loaded, and the coal is not so much broken.

The *Whateley Hall* is to carry 6,200 tons dead weight on a draft of 22 feet 6 inches, and with 1,350 I. H. P. she will have a sea speed when loaded of 9 knots at low coal consumption. The vessel is built to the order of Mr. Edward Nichol, of Cardiff. The ship was built in three months.

Canadian Fisheries' Cruiser.—The cruiser *Canada,* built by Messrs. Vickers' Sons & Maxim, Ltd., to the order of the Canadian government, for the protection of the fisheries around the extensive seaboard of the dominion, recently arrived on this side of the Atlantic. The dimensions of the *Canada,* which permit her to pass through the canals to the great lakes, are: length between perpendiculars, 200 feet; breadth, molded, 25 feet; depth, 14 feet. She has an armament of 4 rapid-fire guns. A speed of 17 1-4 knots was obtained on trial, the engines indicating 1,800 horse power. The machinery consists of two sets of triple-expansion engines, 15, 23 1-2, and 38 inches by 22 inches stroke. There are two single-end boilers 12 feet 9 inches diameter by 10 feet 9 inches long, built for a working pressure of 180 pounds.

Speed Test of the Cruisers Columbia and Minneapolis.

On a run from Newport to Norfolk of the three cruisers assigned to the training-ship squadron, the *Minneapolis, Columbia* and *Prairie,* it was decided to test the speeds at natural draft of the first two mentioned cruisers, which, when they were commissioned, were the fastest war ships of the fleet. On August 26, at 1 o'clock, when the squadron was off Block Island, the race started and continued for eight hours. The *Columbia* took the lead, and it is reported averaged a speed of 20 knots, with 20.77 as the maximum reached. The *Minneapolis* was delayed two hours and fifteen minutes in coupling the engine for the third screw, and when she started ran the course at an average speed of 19 knots.

These two sister ships were built by Wm. Cramp & Sons ten years ago, and the contract speeds were 22.8 for the *Columbia* and 23.07 for the *Minneapolis.* The general dimensions of each ship are as follows:

Length on load water line	412 ft. 0 in.
Breadth, extreme	58 ft. 2 1-4 in.
Mean draft, normal	22 ft. 6 in.
Displacement, normal	7,375 tons

Each ship has triple screws, triple expansion engines and Scotch boilers. It had hardly been anticipated that the cruisers would make such a good showing under natural draft. In 1895 the *Columbia* made a record voyage across the Atlantic at a rate of 18.4 knots.

International Engineering Congress.

Under the auspices of the American Society of Civil Engineers, the International Engineering Congress has arranged to hold sessions at the World's fair, St. Louis,

UNITED STATES CRUISER MINNEAPOLIS, WHICH RECENTLY RACED WITH THE COLUMBIA.

on October 3 to 8, 1904. The office of the secretary of the congress is 220 West 57th street, New York, N. Y. In all over one hundred specialists have agreed to contribute papers. The congress is divided into eight sections, viz.: waterways, municipal, railroads, materials of construction, mechanical, electrical, military and naval, and miscellaneous. Under military and naval papers on naval architecture will be contributed by W. L. Capps, Rear Admiral, Chief Constructor, U. S. N.; Sir William H. White, K. C. B., F. R. S., Pres. Inst. C. E., late director of naval construction, England; T. Kobayashi, Osaka, Japan.

Two papers will be read on marine engineering by W. F. Durand, M. Am. Soc. M. E., Stanford University, Cal.; N. Daymard, Ingenieur en Chef, Conseil de la Compagnie Generale Transatlantique, France.

The following named gentlemen will contribute papers classified under dry-docks: M. T. Endicott, M. Am. Soc. C. E., Rear Admiral, Chief of Bureau of Yards and Docks, U. S. N.; Cuthbert A. Brereton, M. Inst. C. E., London, England; Luis Luiggi, Director General, Obras del Puerto Militar, Buenos Aires, Argentine Republic; Paul Joly, Inspector General des Ponts et Chaussees, France; V. E. Tomonoff, M. Am. Soc. C. E., St. Petersburg, Russia.

Axiom System of Lubrication.—The Axiom system of lubrication for marine engines, used for several years on many British ships, is described in the London *Engineer* of recent issue. The lubricant employed is of the solid type as opposed to fluid, and is much like ordinary lard, although its composition is a secret. The apparatus consists essentially of a gun-metal cylinder placed horizontally containing a tightly-fitting piston which is forced forward by a ratchet and pawl arrangement. The lubricant is forced through a series of jointed pipes to the various bearings. By means of a set of change gearing on the ratchet the speed of advance of the piston may be regulated within wide limits. There is also a hand wheel by which the piston may be screwed forward and lubricant forced out for flushing. With the automatic arrangement the lubricant is forced to the bearing continuously in a definite quantity. A special design of joint has been made for the pipes carrying lubricant to the moving parts, and it is claimed that with this joint no leaks occur. The amount of lubricant required is estimated to be about 3 1-2 to 4 pounds for 1,600 horsepower engine for 12 hours against which 8 gallons of oil will be required for the same work. Another saving claimed is that it is not necessary to wipe the engin down after coming in port with the Axiom system installed.

Gunboat Woodruff.—The first war vessel built in the Philippines by the army, under the direction of the Quartermaster's Department, the *Woodruff*, was launched at Manila on June 29. The vessel was christened after Lieutenant Woodruff, who was killed by Moros. The *Woodruff* will be used by General Wood in the rivers of Mindanao during his campaign in that island.

The Armstrong Works at Elswick.—A sketch of the great shipbuilding and arsenal works of the firm of W. C. Armstrong, Whitworth & Company, Ltd., at Elswick, England, from a small beginning of Lord Armstrong, in 1846, is given in *American Machinist*, September 1. Some interesting interior photographs of the works show the immense gun and assembling shops where the heaviest ordnance for the battleships of all nations are constructed.

THE GYROSCOPIC EFFECT OF FLY WHEELS ON BOARD SHIP.*

BY HERR OTTO SCHLICK.

Ever since our forefathers first began to navigate the seas, the tossing to and fro of vessels in disturbed waters has made itself unpleasantly felt. It is not only that the physical welfare of the passengers and crew has to suffer by it, but it detracts considerably from the precision of aim of the guns of war vessels, and interferes with the rapid performance of the daily work on vessels of all kinds. In view of this it has been the constant endeavor of shipbuilders so to design their vessels that they may be as steady as possible in stormy weather. In general, the attempts made to prevent pitching, or as far as possible to reduce it, have, by reason of the magnitude of the momentum involved, proved unsuccessful.

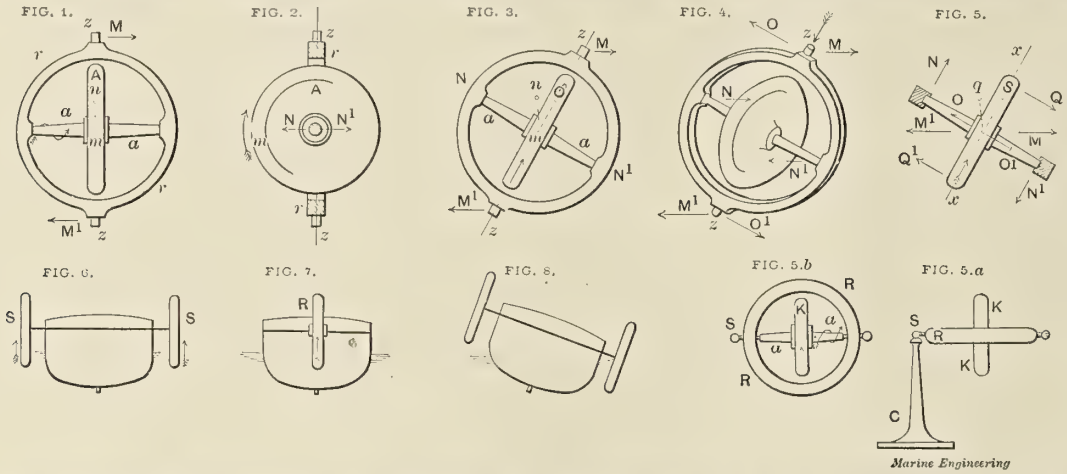
The rolling motions, on the other hand, may be successfully combated in various ways, the chief of which are, firstly, the increase in the period of the vessel's transverse oscillations; and, secondly, the adoption of various means for rapidly reducing their magnitude, when set up by waves. The attainment of both these ends by one and the same appliance has not hitherto proved feasible. The means ordinarily employed to obtain a long period of oscillation consist in an increase of the moment of inertia and a reduction of the metacentric height. The limits within which these means can be employed, are, however, very narrow, and their success is therefore only moderate. The appliances employed to reduce the angles of heel consist principally in the fitting of bilge keels and rolling chambers. Allusion may also be made to a very ingenious device employed by Mr. Thornycroft, and described by him at the spring meeting of 1892.

If you will allow me, I will now bring to your notice an appliance proposed by myself, the employment of which makes it possible, not only considerably to increase the period of oscillation of a vessel, but at the same time effectively to lessen her angle of heel. It depends, in principle, on the gyroscopic action of a fly wheel, which is set up in a particular manner on board of a steamer and made to rotate rapidly.

*Paper read before the Institution of Naval Architects, March 24, 1904.

To enable what follows to be better understood, a statement of the fundamental principles of the theory of the top, in so far as this is possible without a resort to abstruse mathematical investigations, may be here allowed, this being a field with which practical engineers are not, as a rule, very familiar. I must at the outset, however, point out that the following explanations make no pretense to completeness, and that, as already observed, only the more important points can here be touched upon.

Fig. 1 shows the front view, and Fig. 2 the side view of a fly wheel *A*, which may be assumed to be revolving about a horizontal axis *a* in the direction indicated by the arrows. The axis *a* is borne in a ring *r r*, which can revolve in the journals *z z*, about an axis which is first assumed to be vertical. A particle of mass *m* on the circumference of the fly wheel has for an instant a velocity in the vertical upward direction, and has, according to the law of inertia, the tendency to preserve both its speed and its direction of motion. It may be assumed that by the action on the system of an extraneous couple *M M'*, the ring *r r* is turned in its own plane through a certain angle, so that the axis *a a* of the fly wheel becomes inclined, and takes the new position shown in Fig. 3.



While the particle *M* of the fly wheel periphery in Fig. 1 is making for *n*, the inclination of the axis *a a* occurring simultaneously would compel it to go to *o*. But, since we have assumed that the ring *r r* can revolve in the journals *z z*, and consequently that the axis *a a* also can turn in a plane that is at right angles to the one in which the turning was first brought about by the couple *M M'*, it thus becomes possible for the point *m* (see Fig. 3) to reach *n* instead of *o*, the axis *a a* turning the while in the plane lying at right angles to that of the diagram in Fig. 3. In this the end of the axis *a a* marked *N'* will move toward the spectator, and the end *N* away from him, and the whole will assume a position such as is shown in perspective in Fig. 4.

A particle of mass lying on the back of the fly wheel at the point farthest removed from *m*, is, as may readily be seen, subject to the action of exactly similar forces, which also tend in the same manner to produce a turning of the axis *a a*. If the fly wheel, assumed in the position illustrated in Fig. 4, be viewed in the direction of the large arrow, it appears as illustrated in Fig. 5.

The plane of the fly wheel is caused to turn by a second couple $Q\ Q'$ or $N\ N'$, and is brought into the new position $X\ X$. In view of this, the direction of motion of a particle of mass p of the periphery will also be diverted, and instead of reaching q will be forced to move to s. By this another (third) couple $O\ O'$ is produced, in the same manner as was above illustrated, acting almost in direct opposition to the first one $M\ M'$, which produced the turning $r\ r'$ of the ring, and having the tendency to prevent the latter from turning.

It is important that we should keep before us the fact that this third couple $O\ O'$ cannot come into existence if the inclination of the axis of the fly wheel can take place only in one single plane. If, that is to say, the ring $r\ r$ were not made capable of being turned about the journals $z\ z$, and the imparting to the fly wheel of the deviation illustrated in Fig. 5 became impossible, no obstacle to the action of the original couple $M\ M'$ would present itself. The rapidly revolving fly wheel would allow itself to be brought into the position illustrated in Fig. 3 with the same ease as if it were at rest.

The above described properties of the gyroscope are familiar to us in a somewhat different form in connection with the well-known toy known as the Archimedean top. The latter consists essentially of a small fly wheel K (see Figs. 5*a* and 5*b*), which is borne in journals in a ring R in such a manner that it can easily rotate about the axis $a\ a$. If the fly wheel be made to rotate rapidly and the ring be supported at the point S by means of a ball-like projection resting in the cup-shaped head of a strand C, the ring does not respond to the influence of the force of gravity by falling from the stand, as it might be expected to do, but remains poised in the horizontal position, and turns slowly in the horizontal plane round the point S.

The same phenomena are here observable as were illustrated above. The force of gravity in the first place acts on the ring bearing the fly wheel and resting on a support at one side, so as to try to move ring and fly wheel downwards, which action causes a turning of the axis in a vertical plane.

This turning (or twisting) movement produced by the first couple in this case also brings a second couple into play, which produces the clearly observable rotation of the ring about the point S in the horizontal plane through the latter. This rotation in its turn brings the third couple into play, which neutralizes the first one resulting from the action of gravity, so that the weight of the ring with the fly wheel apparently disappears altogether.

On the principle just explained, depends, as we know, the possibility of using the bicycle. As soon as the latter (viewed from behind) leans in the slightest degree to the right, a turning (or twisting) motion of the driving wheel takes place, of such a nature that the bicycle turns slightly to the right, and the common center of gravity thereby moves over to the left-hand side of the point of support. An essential condition of this is that a certain degree of speed should be developed, and that the position of the point of support should be removed at a more rapid rate than that at which the sideways movement of the common center of gravity due to the inclination of the bicycle takes place. A slight inclination of the bicycle to the left then ensues, which, in a manner analogous to the first case, also produces a movement of the bicycle, this time to the left, followed by a slight movement of the common center of gravity to the right. An oscillation, in fact, takes place about the position of equilibrium, the bicycle the while describing a long drawn-out serpentine path. It is, moreover, impossible for a bicycle to be made to travel in an absolutely straight line.

After the above preliminary remarks it will be possible to make clear the effect of a rotating fly wheel on a ship.

An ordinary paddle steamer possesses two wheels of equal weight, which, it is true, turn at a comparatively small velocity, but the influence of which must, according to what has been said, to some extent make itself felt. Their effect, so far as the conditions above illustrated come into play, is exactly the same as if two fly wheels were hung one on each side of the vessel, having the same angular velocity and the same moments of inertia as the paddle wheels. The effect produced by these two fly wheels $S\ S$ (see Fig. 6) would be in nowise altered if they were replaced by a single wheel R (see Fig. 7) within the vessel, having a moment of inertia equal to the sum of the moments of the two.

If these assumed fly wheels be made to revolve, an inclination of their axis—*i.e.*, an inclination of the whole vessel will produce phenomena exactly similar to those which we studied in connection with Figs. 1 to 5.

In Figs. 6 to 8 the cross section of the vessel is supposed to be viewed from the stern. Further, we may suppose that the rotation of the fly wheels takes place in the direction shown by the arrows, which corresponds with that in which paddle wheels turn when a vessel is going ahead.

Let us assume that the vessel is, by the action of a wave or from some other cause, inclined over to starboard, so as to take a position as shown in Fig. 8. According to the explanations above given, a couple will now be found, tending to turn the bow of the vessel round toward the starboard side; and, as a matter of fact, a slight turning movement of this nature actually does take place, as careful observations made on a paddle steamer, the side of which is exposed to a high-running sea, will always prove. This turning motion in a horizontal plane, as already shown, produces a third couple that acts against the first inclination of the vessel, and in so doing partly removes the cause of the first inclination. In this way the well-known fact that paddle steamers roll less than screw steamers may be explained; a phenomenon for which, so far as I am aware, no satisfactory explanation has to this day been given.

From these observations it follows that in the case of a paddle steamer to which a turning motion of the bow toward the starboard side has been given by the rudder, a couple is produced tending to incline the vessel over to port, and *vice versa*. According to this, it is also evident why a paddle steamer inclines considerably to one side when the rudder is put over.

An experiment made with a small model of a vessel, having a fly wheel set on a horizontal axis at right angles to the direction of the length, shows the effects here described in a very clear manner, as soon as the fly wheel is set in rapid motion. The influence tending to lessen the rolling motion would show itself still more clearly if the vessel, during a roll, could turn through a greater

angle in the horizontal plane. Since, however, it must always keep an approximately straight course, the turning motion remains very small, and the effect of the third couple produced by the latter motion also remains small in amount. The peculiar behavior of paddle steamers in a seaway, which differs materially from that of screw steamers, is completely explained by what has been said above.

When, be it observed, a paddle steamer heels to starboard, and the starboard wheel in consequence dips further into the water, a turning of the vessel ensues, not to port, as one would expect, but to starboard, and *vice versa*. The gyroscopic influence of the paddle wheels on the steering, in fact, in part counterbalances the influence exerted by them on the water. Otherwise it would be still more difficult than it now is to keep a straight course with a paddle steamer in stormy weather.

If it be desired more effectively to control the rolling motion, a greater deviation of the fly wheel must be rendered possible without the latter being too much influenced by the motion of the vessel in the horizontal plane; or, in other words, by alterations of her course. This may be effected by placing the axis of the fly wheel, when in a normal position, vertically. The vessel can then make any desired change, of course, without her influencing the fly wheel, or the latter influencing her.

The phenomena which present themselves in connection with an arrangement of this kind may best be studied by the help of a model, such as that illustrated in Fig. 9. This shows a pendulum which is able to swing to and fro on an axis at *n*. Above, the pendulum takes the form of a semicircular fork piece *B*. A ring *R* is hung on the point of the screw pins *p p*, in such a manner that it can turn about a horizontal axis through the center of the fork piece. In the ring itself, which is so weighted at the point *S* that, when inclined by any means, it will always return to the upright position, a vertical spindle *a*, carrying the fly wheel *F*, is set in bearings. If the pendulum be set swinging without the fly wheel being made to rotate, it will be found to move to and fro with a certain definite period. The frame in which the fly wheel is borne may first be allowed to move as easily as possible—*i.e.*, with a minimum of friction. If the fly wheel be then set spinning and the pendulum receive a push, the latter will, in the first place, show a considerably increased period of swing.

The fly wheel oscillates with its frame during the swings of the pendulum with a so-called phase difference of 90 degrees; that is to say, the swings of the axis of the fly wheel keep lagging behind those of the pendulum by a quarter of a swing. While the pendulum is passing its central (vertical) position, the axis of the fly wheel will show its greatest inclination; and when the pendulum is in the outermost position of its swing, the axis of the fly wheel stands exactly in its middle position. The amplitude, or extent of the swing, of the pendulum will, as theory tells us, not be influenced thereby, but will remain exactly as great as before. That this is the case will also be readily apparent, since no consumption of energy takes place in the apparatus, the period only being influenced by the increase which takes place in the swinging mass.

Were it possible to fit a fly wheel of this kind, able to swing in its frame without experiencing friction, into a vessel, this would be advantageous in so far that, to begin with, the rolling motions would become slower, and therefore less unpleasant; and then, on account of the great difference thus produced between this period and that of the waves, they would cease to be of any consequence. The rolling motions of the vessel would then become considerably less in extent. If the frame which bears the fly wheel be screwed tight on the model, so that it can no longer turn, the effect hitherto produced by it will cease, and the pendulum will swing with the same period as it would if the fly wheel were not rotating.

It will readily be seen that the effect produced upon the swings of the pendulum by the rotating fly wheel can be of greater extent only so long as the plane of the frame bearing the fly wheel remains approximately vertical.

If the axis of the fly wheel be inclined at an angle a to the vertical, the moment thus produced, acting against the motion of the pendulum, will be proportional to the value of cos a. Should the axis of the fly wheel momentarily become horizontal, a position which with a pendulum in violent motion it may almost reach—that is to say, should a equal 90 degrees and cos a equal 0—the influence of the fly wheel will disappear altogether.

Since, as already stated, there is a phase difference of 90 degrees between the swings of the pendulum and those of the axis of the fly wheel, the gyroscopic influence on the pendulum must be least in amount when it is passing the middle position—*i.e.*, at the very position at which it has its greatest angular velocity, because at the same moment the inclination of the axis of the fly wheel is at its greatest, while the velocity with which it is changing its inclination has become very small or vanished altogether. When, on the other hand, the pendulum has reached its outermost position, and is changing the direction of its motion, thus for an instant reaching a state of rest, the axis of the fly wheel then proceeds with its greatest angular velocity through the middle position, the fly wheel thereby exerting its greatest influence. It will thus be evident that the conditions for the exertion of the greatest possible influence of the gyroscopic action of the pendulum are not present here. In order that the motion of the pendulum may be effectively influenced, the oscillation of the frame with the axis of the fly wheel will have to be reduced in a suitable degree. In the model illustrated in Fig. 9, this may be most simply effected by tightening the screws to a suitable extent, so that they act as a brake on the motion of the fly wheel. The swings of the fly wheel frame are thus reduced in extent, and the phase difference between the two swinging movements here described now becomes less than 90 degrees.

If the experiment be made of setting the pendulum swinging with the brake thus applied to the fly wheel frame, a very different phenomenon will be observed. The pendulum will indeed still swing with a very considerable period, but the maximum angle attained becomes considerably reduced with each successive swing, so that a state of rest is reached even after two complete swings. In scientific language, the oscillation of the pendulum experiences a damping, in that the energy stored up in it is destroyed by the friction applied to the fly wheel frame.

The gyroscopic action of a rotating fly wheel has in the above been illustrated as applied to a pendulum. It will readily be seen that it may be applied in a similar manner to retard the rolling motions of a vessel. In Figs. 10*a* and 10*b* the vertical axis of the fly wheel *W* is set in bearings in a large frame *F F*, which can turn on the journals *P P*, about a horizontal axis lying at right angles to that of the vessel. It may be made to rotate rapidly by means of an electromotor or a steam turbine.

Fitted to a frame is a journal *p*, which is connected with the piston rod of one or of two hydraulic brake-cylinders *C*, and, by the throttling of the area of the communication tube, enables the swings of the frame *F F* to be braked at will. The frame is ballasted at its lower side by a weight *G*, as was done on the pendulum model, or the journals *P P* may be fitted somewhat above the position of the center of gravity of the whole frame. As soon as any outside influence begins to heel the vessel over in a direction at right angles to its length,

FIG. 9.

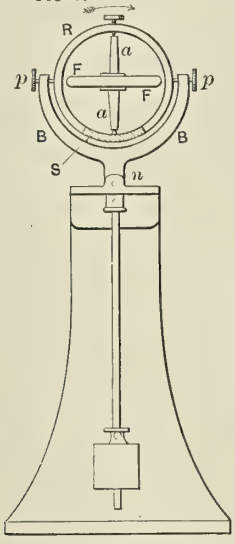


FIG. 10.*a*

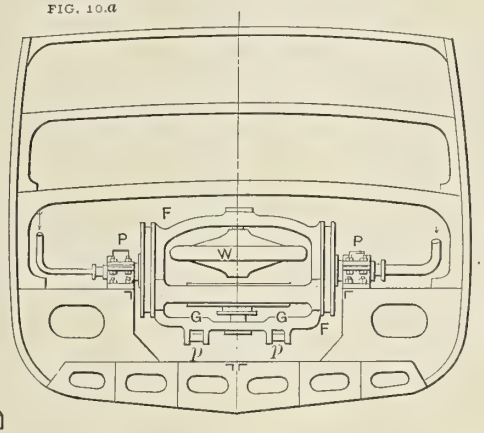
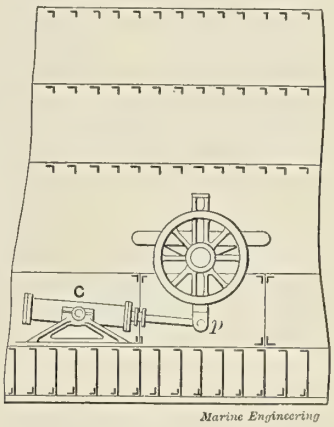


FIG. 10.*b*



Marine Engineering

the fly wheel frame will incline considerably, with the result, as in the case of the pendulum model, that moments are produced which not only render the oscillations of the vessel considerably slower, but also very considerably reduce their extent. But these two conditions are exactly the ones which alone are calculated to destroy the rolling motions caused by the waves. A vessel fitted with the appliance illustrated would, according to this, only be subject to insignificant rolling motions. On the other hand, the frame, with its fly wheels hung up within the vessel, would swing violently to and fro.

In addition to the hydraulic brake, it will be necessary to fit one or two powerful band brakes, which will enable the fly wheel to be held at large angles of, say, more than 45 degrees, or prevented from exceeding these. In very stormy weather, in which considerable inclinations of the fly wheel are to be expected, a man will have to be told off to attend to this band brake.

In view of the model here exhibited, the conclusion must be come to that the energy communicated to the vessel by the action of the waves can be transferred to the fly wheel, and may, by means of the brake fitted to the latter, be destroyed. The hull of the vessel only transfers to the fly wheel the energy produced by the waves; and, according to the theory of the top, a very small inclination of the vessel will enable it to do this. In the appliance described we have an excellent means, if not of preventing the motions of the vessel, of at least reducing them to a minimum.

In the case of a vessel the effect of a fly wheel will not, of course, show itself in such a striking manner as in that of the model. In the latter the conditions are, in regard to dimensions, exaggerated; for the diameter and weight of the wheel are greater in proportion than they could be in a real case.

On the other hand, it must be remembered that the circumferential speed of the fly wheel on the model is only about one-tenth of that which, in view of the scale of the model, it ought to have, since the electro-motor cannot make it go faster. The exaggeration, then, in the model of the action in question is not so very great as at first sight it may appear.

The question may now be asked, whether the action of a fly wheel of the dimensions that may fairly be adopted in a vessel, will really be sufficient to exercise a marked influence on her rolling motions; and, again, whether the diameter of a fly wheel that can exercise a markedly damping influence on the rolling motions of a vessel, is not so great that the whole arrangement becomes practically impossible or unsuitable for the purpose intended.

Before this question could be satisfactorily answered, it was necessary that the system should undergo scientific examination. This difficult work was undertaken by several professional men, viz.: by Professor Sommerfield, Professor H. Lorenz, and Professor Föppel. The last-mentioned gentleman went very carefully into the question, and worked out the elaborate calculations for a definite example. The calculations went to show that even with large vessels a considerable effect may be produced by the apparatus. The mathematical investigation of Professor Föppel, which underlies the calculations, is given in the appendix to this paper.

In order to render the following results intelligible, a circumstance must now be referred to which has hitherto been disregarded.

The motions of the axis of the fly wheel are not confined to the swings which it makes in a period equalling that of the rolling motions of the vessel, but comprise, also, small oscillations of very short period, which, in connection with the theory of the top, are called "nutations." When the speed of rotation is great, both the amplitude and the period of these oscillations are very small, but as the speed decreases these both increase. The nutations may be clearly observed in the spinning of every top after its speed has considerably lessened, in the shape of the well-known reeling motions that it goes through shortly before its fall. The periods of these small secondary movements are given, amongst other particulars, in the above table.

In order to show the effect of the installation of a fly wheel on board of a medium-sized steamer, the results of calculations made for a particular vessel will now be given. The steamer chosen is one of 6,000 metric tons (5,905.5 English tons), which has a metacentric height of 0.5 metre (17 3-4 inches), and a period of 15 seconds (for the double roll) when not fitted with a fly wheel. On this vessel let a fly wheel 4 metres (15.12 feet) in diameter, weighing 10 tonnen (9.842 English tons), be installed, having a speed of rotation, measured at the periphery, of 200 metres (656 feet) per second. At this speed of rotation, a wheel that is carefully designed and made of the best material may be worked without danger.

The total weight of the fly wheel, with its swinging frame and motor, is taken at about 20 tons, and the arrangement of the axial trunnions of the fly wheel frame is assumed to be such that the distance r of the center of gravity is, according to one design, at a point 0.5 metre (19 5-8 inches) below the axis of motion; while, according to another one, this point is at 1 metre (39 3-8 inches) below the axis. The moment due to the oscillation of the fly wheel frame, and which must be overcome by the hydraulic brake, is taken for an angular velocity equal to 1, and is denoted in the table by the letter k. The angle of phase difference, by which the swings of the frame lag behind those of the vessel is denoted by ν. The figures given in the table show that the effect of the fly wheel on the rolling motions of the vessel is a very pronounced one. For instance, when $r = 0.5$ metre and $k = 26{,}300$ kilogramme metres, the angle of swing is reduced after one oscillation to 0.3 of the starting angle, while for $k = 39{,}000$ kilogramme metres it falls to 0.22.

When, therefore, the vessel has by some means been inclined to an angle of about 4 degrees from the upright, it will, with the next roll reach an angle of inclination of only about 1 degree, and with the second roll have come almost to rest again; while the same vessel without the fly wheel would probably come to rest after from six to seven rolls. The table further shows that the period of oscillation of the vessel is materially increased, by which, of course, the influence of the waves in the production of transverse oscillations is considerably weakened. It will be seen that, in order to obtain as large a period as possible, it is necessary to keep the value of R within certain limits.

In the calculation from which the results here given were taken, the damping effect of the resistance of the water was disregarded. The ship will then in reality come to rest still more quickly than was assumed here. A further result of the calculation is that the secondary oscillations are, on the applications of the brake, in nearly all cases periodically damped, and are therefore of no consequence. There need then be no apprehension that the fly wheel will produce shocks.

The moment to be taken by the brake depends upon the angular velocity with which the fly-wheel frame swings through the vertical position. In the present example this amounts to about 0.16, and if the value of K be taken at 26,300 kilogramme metres, the brake moment will amount to 4,200 kilogramme metres. When, therefore, in our examples the trunnion on which the brake cylinder is to act is taken at a distance of 2 metres from the axis of motion of the fly wheel frame, the brake cylinders must exert a pressure of 2.1 tons.

Since the fly wheel frame makes, as the table shows, inclinations about from ten to eleven times as great as those of the vessel herself, the fly wheel frame might, in the case of very extensive rolling motions, turn right over, which would not be admissible. An appliance must therefore be fitted, taking the form either of a brake strap or of a buffer which will prevent the frame from attaining a greater inclination than about from 30 degrees to 45 degrees.

Le it now be assumed that the vessel has been inclined over by some outside influence to an angle of 18 degrees to starboard—an angle which, in the case of a vessel fitted with a fly wheel, is scarcely admissible. The vessel will, in the course of a half-roll to port, reach an inclination of 13 degrees, and in the course of the next half-roll to starboard one of 8 degrees. During this time the swings of the fly-wheel frame will be so violent that they will have to be stopped by means of the band brake or buffer, at an angle of inclination of about 45 degrees. From the moment when the oscillations are damped down to about 3 degrees they will play themselves out in the manner shown in the table; that is to say, after two more swings the vessel will practically come to rest. Such large inclinations, however, of vessels fitted with fly wheels will not occur at all, for the object of the apparatus is that vessels fitted with it shall never attain to considerable angles of heel.

In the case of a vessel not fitted with a fly wheel, a wave gives a vessel a certain inclination, which is increased gradually more and more by the following waves. This rapid increase of inclination, after the passing of several waves, is only rendered possible by the circumstance that the damping resistance of the water remains very small (even if bilge keels are fitted) so long as the angle of heel has not become considerable in amount; or, in other words, the work consumed by the damping resistance does not become equal to the energy communicated to the vessel by the succession of waves until a very large angle of heel is reached. The violent rolling motions, then, of a vessel not fitted with a fly wheel are the accumulated effect of a whole series of waves. When, however, a vessel is fitted with a fly wheel, the conditions become very materially different. In this case the first small inclinations themselves are subject to a powerful damping action, so that an accumulation of roll can never take place. Herein lies the principal work of the apparatus, and at the same time the guarantee for its success.

It will be of further interest to have for a given vessel a general guide as to how large the fly wheel will have to be made, in order that its effect may be sufficiently great. The same lettering will here be used as in the appendix,* and is as follows:

J is the moment of inertia of the fly wheel about its axis of motion.

ω is the angular velocity of the fly wheel.

θ is the moment of inertia of the vessel about its horizontal longitudinal axis passing through the center of gravity.

u_0 is the greatest angular velocity with which the vessel without fly wheel attains the middle (upright) position, when the angles of roll are equal to Φ_0.

School Ship Pennsylvania.—The Nautical Preparatory School has chartered the American line steamer *Pennsylvania,* for one year, to take the place of the *Young America,* specially designed for this service, but which has not yet been completed. Comfortable living quarters have been fitted on the *Pennsylvania* to accommodate the boy scholars who are to receive their college preparatory-school training on board while cruising around the world. The boys are not to act as the crew, but will be taught navigation and steam engineering in the most practical way.

Rusting of Iron.—New light has been thrown upon chemical reactions involved in the rusting of iron, by a paper recently published in the proceedings of the

The Rolling of Steamers.

—	r = 0.5 metre (19⅝ in.).					r = 1.00 metre (39⅜ in.).	
Moment at brake in kilogramme metres for an angular velocity = 1	k = 8,280	k = 11,700	k = 18,500	k = 26,300	k = 39,000	k = 20,000	k = 48,000
Period of steamer for a double roll	21.8	21.5	21.1	20.6	19.0	18.5	17.6
Coefficient of dampine β_1 in $e - \beta t$ in equation (6) of the Appendix	0.0185	0.026	0.041	0.058	0.079	0.020	0.0415
After a double roll, the angle of inclination is reduced to the following fractions of the starting angle	0.67	0.57	0.42	0.30	0.22	0.69	0.48
Secondary oscillations made by the flywheel: Period in seconds	2.8	3.5	With this brake moment the secondary oscillations are apericodically damped.			3.8	Aperiodically damped.
Secondary oscillations made by the flywheel: Damping	After 1 sec. reduced to ¼	After 1 sec. reduced to ⅛				Considerably damped.	
Ratio $\frac{K_1}{C_1}$, *i.e.*, ratio of inclination of frame of flywheel to inclination of steamer	12.0	12.0	11.6	11.4	9.9	6.78	6.01
Angle of phase-difference γ in equation (10 of the Appendix)	78° 35′	75° 20′	66° 20′	55° 40′	40° 40′	74° 0′	50° 20′

For the attainment of a powerful effect it is necessary that

$$\frac{J\omega}{\theta u_0} = \frac{1}{5}$$

but even if

$$\frac{J\omega}{\theta u_0} = \frac{1}{10}$$

the power of the appliance will, in many cases, be sufficient.

J, it is true, will always be very small in comparison with θ; but, on the other hand, the angular velocity ω of the fly wheel can be very considerably greater than that reached by the vessel in its rolling motions during stormy weather; and it will therefore be possible to bring the ratio just mentioned within the necessary limits. It is, indeed, to be expected that the carrying out of the arrangement here outlined will meet with many and perhaps unexpected difficulties, but in the present state of engineering science, it may also be confidently expected that these will be overcome. So far as can at present be judged, it is to be expected that the arrangement may be successfully applied to steamers of moderate dimensions, such as cross-channel steamers and others serving similar purposes, and that the disagreeable effects which, for very many passengers, attach to a sea voyage may be considerably alleviated. However this may be, I wish to emphasize that in the preparation of the present paper my principal aim has been to create interest in the scientific aspects of the proposal, while leaving to the future the question of the putting of it into practice.

*Space does not permit publishing the Appendix.

Chemical Society. The results suggest that electrolytic action is involved. It seems that when pure iron is left in contact with dry oxygen it does not rust. Moreover, iron does not rust when left in contact with mixed oxygen and water vapor, so long as the temperature is kept constant. If, however, the temperature be allowed to fluctuate, so that the water vapor condenses in water on the iron, rusting takes place. Again, rusting is stated not to occur if pure iron is immersed in pure water free from oxygen. But if the water absorbs oxygen, rusting occurs. Consequently, it would seem that the rusting of pure iron requires the presence both of liquid water and of oxygen, neither being in itself sufficient. A large number of attempts have been made to produce a non-rusting iron, or to give a surface to iron which will not rust. Nickel plating is the best expedient which has been found, although there are manifestly many cases in which this expedient cannot be applied. Any cheap plan which would enable surfaces of iron and steel to be preserved from rusting would add materially to the world's wealth,, because, at the present time, the annual rate of destruction of steel commodities, rails and structures aggregates a gigantic international loss. The subject is usually regarded as entirely within the province of chemistry, but this is by no means necessarily the case. In the first place, the existing expedient of nickel plating is an electrolytic process and is, therefore, a subject of electrical interest. In the second place, the nature of rusting seems to involve electrolytic action, so that a complete comprehension of the phenomenon is likely to extend beyond the limits of chemistry, as ordinarily defined.—*Electrical World.*

SALVING AND REPAIRING THE STEAMER EKLIPTIKA.

Two years ago the steamer *Ekliptika,* while bound from England to the Baltic, with 3,000 tons of cargo, was carried out of her course by currents and stranded on the coast of Sweden, close by the Pater Noster Sheeren, and eventually sank in about fifteen fathoms of water, on rocky ground. The ship was built in 1897 under a patent system of construction somewhat similar to turret steamers, by the Flensburg Shipbuilding Company for the Urania Steamship Company, of Copenhagen, and is of 2,167 tons gross register. A year after the vessel had sunk the contract was given the A. S. Moss Vaerft Bjernings-og Dykker Company for raising the vessel, and after several months of difficult work they were successful in bringing her to the surface. She was then towed to the company's dock, at Moss, and the accompanying illustration shows the method of raising the ship with four lighters.

METHOD OF FLOATING THE STEAMER EKLIPTIKA, SUNK ON THE COAST OF SWEDEN, BY MEANS OF FOUR BARGES.

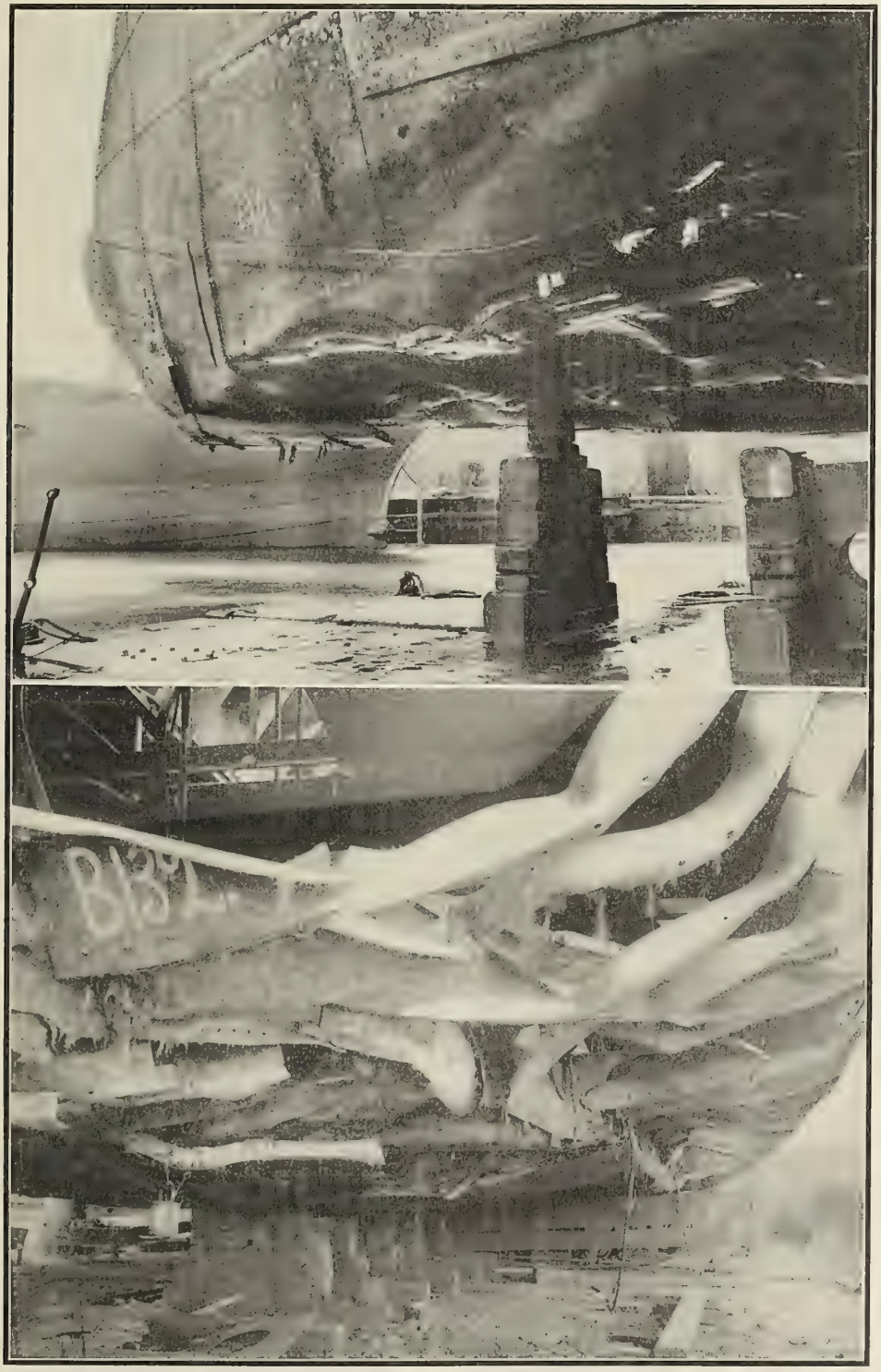
After the *Ekliptika* was inspected it was decided to repair her, and bids were tendered by many of the Swedish yards, all of which required six months for delivery. The contract, however, was intrusted with the builders of the ship, the Flensburg Shipbuilding Company, and the 1st of May, this year, the builders sent their tug boat with necessary divers and outfit to bring the steamer to Flensburg. On the 4th of May the *Ekliptika* left the Norwegian harbor in tow of two tugs, and the first part of the journey under light winds and calm seas was made without mishap. Later, however, when the wind and sea rose the steamer labored a great deal, and eventually sprang aleak, the water making head so fast in the forepeak that the pump was of little or no avail. The tug boats with their consort put in at Fredrikshavn, where the leak was made tight by the divers, and the next day the journey was continued with good weather. Toward evening, however, the wind and sea rose, so that the ship began to pitch and make considerable water. She was obliged again to put into port, this time at Ebeltoft, where the leakages were made tight by the divers by means of cushions and sails. The rest of the journey was completed through the Little Belt and the Alsen sound without further difficulty, so that on the night of May 10 the ship was moored alongside the wharf in the yard at Flensburg.

Salvage pumps were kept working continuously. After a few days the ship was docked to patch up the leaks temporarily and to make a thorough inspection. The bottom was damaged from stem to stern. All the shell plates up to above the margin plate of the tank were badly bent and punctured. The floors and tank top were all bent; the stem and stern posts were broken, and on the port side of the after hold there was a large hole about 50 square feet in size. The hull stanchions and beams were all either bent or broken; there was nothing at all left of the cabin fittings and crew-space equipment; the pipes on deck, the loading and discharging gear; the boats, companion ways, skylights, and railings were all either broken or lost. After it was found how many new plates and shapes would be necessary, the vessel was floated out of the dock in order to allow other ships which were waiting for repairs to be drydocked.

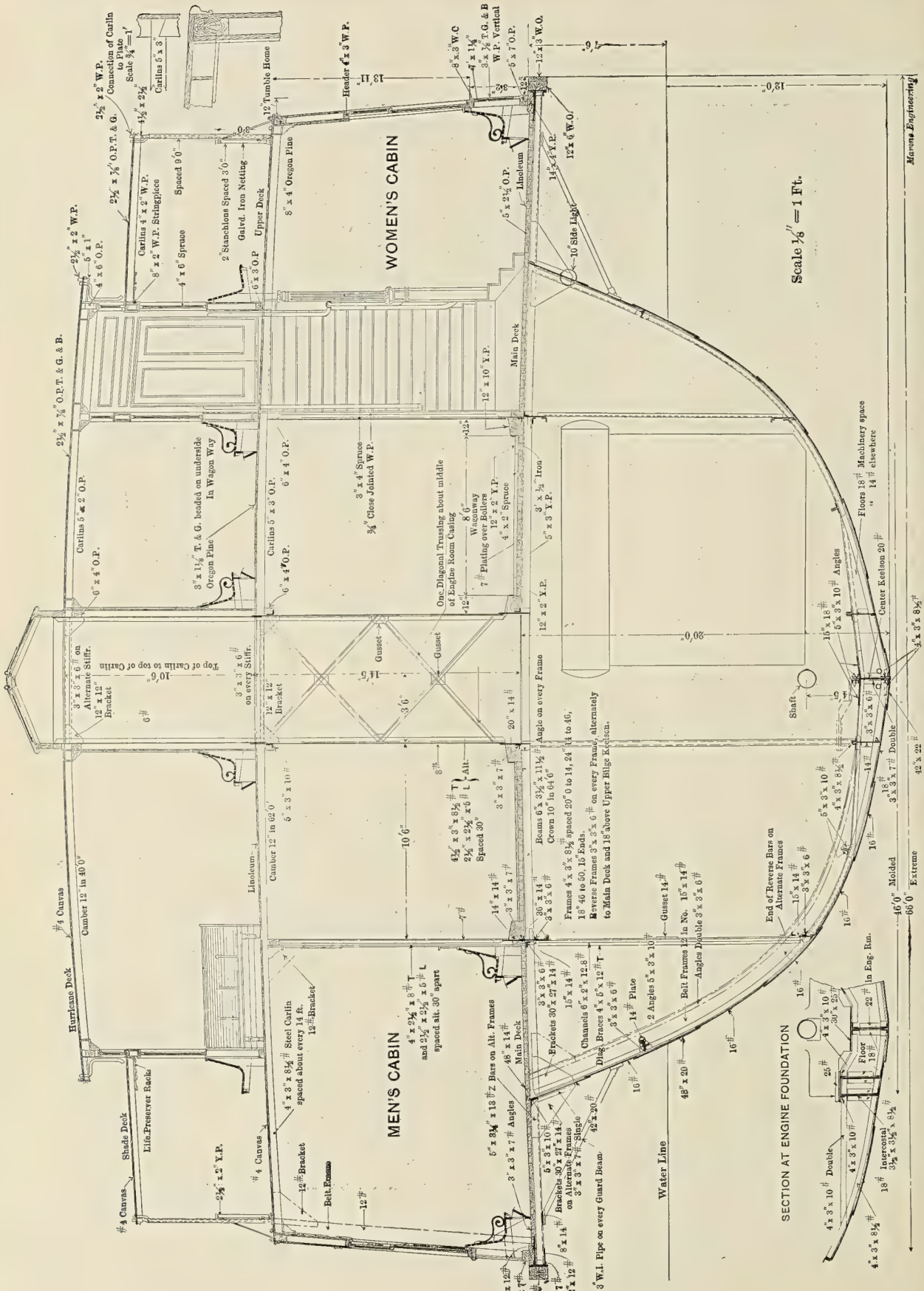
Work of repairing the *Ekliptika* was commenced on June 23d, on which day she was docked, and a large number of men were immediately put to work on the bottom of the forebody of the ship with pneumatic tools and machines. Because of the torn and bent condition of the bottom it was impossible to remove the plates by drilling out the rivets, so the bottom was cut out athwartships in pieces of about 50 feet in length. The bulb frames and stringers were also cut off, so that after a few days the whole upper forebody was resting on two rows of props, one on each side of the vessel. The new

members were now erected and riveted in place, new plates were fitted or old ones straightened, new stem and stern posts fitted, so that by August 6, after incessant working, the new bottom was complete.

On the 8th the ship was once more taken out of dock and moored alongside the company's wharves where work was continued on deck. The entire work, which was done while the ship was in dry-dock, required but thirty-nine working days. This may be regarded as an excellent result and reflects great credit on the shipyard.



VIEWS OF THE FOREFOOT AND FOREBODY OF THE SUNKEN GERMAN STEAMER EKLIPTIKA.



MIDSHIP SECTION OF THE NEW STEEL FERRYBOATS FOR THE NEW YORK-STATEN ISLAND SERVICE, BUILDING BY THE MARYLAND STEEL COMPANY.

FERRYBOATS FOR THE NEW YORK-STATEN ISLAND SERVICE.—II.

In describing the construction of the new Staten Island ferryboats, mention will be made of only those scantlings and features which are not mentioned on the midship section given in this article, or on the inboard profile, page 408, in the September issue.

There will be two stern frames and stems of open-hearth cast steel, the arch from the stern post to stem will be of through-section, molded to the shape of the hull, and having an extension below to receive the gudgeon casting. The frame is to be cast with a boss for the propeller, and to have a shoe extending about 7 feet into the hull. A section of the stem will be 4 by 10 inches rabbited to receive the hull plate, and to have a fender piece to protect the upper part of rudder, and to be tapered to cut the ice.

The dish-plate keel is to be 22 pounds weight throughout, and to be connected with the stern frames by treble zigzag riveting. The center keelson will be a continuous vertical plate 23 1-2 inches by 20 pounds, except in engine space, where it is increased to 22 pounds weight and of sufficient depth to steady the engine foundation. It is to be cut out for reverse frames and heel pieces.

There are to be two plate bilge keelsons on each side, one on a line with the upper engine keelson, the other on a line with the longitudinal truss frame; also one plate stringer on each side of boat at the line of the guard brace heels. There will also be one double-angle bilge keelson on each side, between the upper and lower plate bilge keelsons. All keelson angle bars are to be carried continuously through transverse water-tight bulkheads with water-tight angle staples fitted around them, into the ends of the boat, and connected with plate breast hooks.

The frame spacing and scantlings are given on the midship section. The bulkhead frames are to be double 3 by 3-inch by 7 pounds finished to form staple at deck and center keelson. The long reverse frames are to be butted at the middle line with 36-inch heel piece rove through the keelson. The shorter bars are to be rove through scores in the center keelson plate and fitted with bosom angle butt straps on alternate sets of frames. The reverse frames are to be doubled in the engine room and under the boilers to 18 inches above the truss keelsons. The floor plates are 18 inches deep and of scantling shown on the section, except at bulkheads, where they are to be 16 pounds, and to extend 6 inches above the keelson angles. The transom floors are 20 pounds.

There are to be twelve belt frames, as shown on the hold plan, page 409. The beams at bulkheads are to be double 3 by 3-inch by 7 pounds angle and at the engine and boiler hatches, and the transom and fantail beams are to be 9 by 3 1-2-inch by 23 pounds channels.

The shell plating is to be laid in in-and-out strakes lap-jointed. The water-line strake to be 24 inches above and 24 inches below the water line, and 20 pounds per square foot, except at the ends of the boat, where it is to be increased to 25 pounds, or a distance of 30 feet from the stem post. The stringer plate, which is 48 inches wide at the butts, lies half over the hull and half over the guards. The center tie plates and side tie plates over longitudinal girders are 36 inches by 14 pounds. For a distance of 30 feet from each end of the boat the deck is to be plated from guard to guard with 10-pound plates. The deck beams in the center house around the smoke stacks are to be plated with 8-pound plate and fitted with plate shutters to make the fire room air tight.

At either end of the boat a hatch is provided of sufficient size to remove the rudder quadrant. Hatches will be fitted to each of the coal bunkers and fire rooms, and to the steering-engine compartments. There will be six water-tight steel bulkheads, as shown on the plans. The collision bulkheads are to be of 12-pound plate stiffened by vertical angles 4 by 3-inch by 8 1-2 pounds spaced 21 inches apart, and horizontal bars of same scantling spaced 4 feet apart. These bulkheads will have 30-pound patch plates bolted around stern-tube openings. The other thwartship bulkheads are formed of plates, the lower one-third of 12 pounds, the upper two-thirds of 10 pounds, with the same stiffeners as the collision bulkheads except that the spacing of the vertical bars is to be not more than 27 inches. Each bulkhead is to have a brass sluice valve as low down as possible and operated from the main deck. Cast-iron collars in halves and 25-pound patch plates are to be fitted where the shaft passes through bulkheads.

The longitudinal truss frame is to be fitted at each side of the boat in line with the cabin bulkhead and carried as far into the ends as practicable. The construction of this is shown in midship section. Channel stanchions spaced about 8-feet centers are fitted to vertical plates at top and bottom; the diagonal braces are of T-section. The top and bottom members of the truss are to be well bracketed to the transverse bulkheads. Stanchions are to be placed on each side of the boat on a line with the center-house bulkhead, spaced about 12 feet apart and formed of 3-inch extra heavy wrought-iron pipe with forged heel and heads welded in. Forward and aft the center house, 6-inch by 12.8-pound channel bars are to be worked continuously under the beams to form ridge bars for stanchion heads.

The engine foundation is clearly shown on the section drawing and other foundations are to be built of angle and steel plate to suit the boilers, bearings, and other machinery. All foundations are to be built as far as possible so that angle bars will take the holding-down bolts.

The coal bunkers are to be of 10-pound plate with 3 by 3-inch by 7-pound angle stiffeners spaced 27 inches centers. The bottom of the bunker is to be formed of 14-pound plates inclined to trim the coal toward the doors. The ash pits are of 12-pound plates. At the ends of the boat the fantail beams are to be 9 by 3 1-2-inch by 23-pound channels radiating from the transom beam.

Between the hull and the guard-face plate, under the fantail beams, the plating is to be of 12 pounds. The remaining of this construction, as well as that of the center house and wagon-way sides, are shown in the section. All doors in the iron housing are to be of plate. The steering columns are to be about 42 inches long and 24 inches wide, built of 10-pound plate, from the main to the upper deck, and 6-pound plating above, stiffened with 4 1-2 by 3 by 8 1-2-pound T-bars.

The shell plating is to be double zigzag, riveted to the stem and stern post by rivets 1 inch diameter, 5 inches

pitch, treble riveted on and below the propeller boss, the heads and points being finished slightly convex. Keel and garboard laps to be double chain riveted with 7-8 inch diameter rivets. Other ridge laps of outside plating to be 3-4 inch riveted, 3 inch pitch. The butts of the garboard strakes and the sheer strakes are to be treble riveted, with butt straps 4 pounds heavier than the plates they connect, all other outside plating butts to be double riveted and with butt straps 2 pounds heavier than the plates they connect. Outside plating butts to be 3-4 inch chain riveted spaced 2 3-4-inch centers. Under engines the rivets securing frames and reverse frames to floors, and frames to shell plating, are to be spaced not more than 5 1-2 diameters apart. Rivets through engine-foundation plates to be 1 inch diameter. Rivets connecting these two frames and beams to be spaced not more than 4 inch centers.

Main and guard-deck stringer plates, face plates, and deck tie plates to have double chain riveted butt straps with 3-4 inch rivets spaced 3-inch centers. Keelson stringer butts to have trebled riveted 3-4 inch straps. Belt-frame butt straps to be treble 3-4 inch chain riveted. Rivets for securing frames to floors, reverse frames to frames and floors, keelson and stringer angle bars to each other and to plates, stiffeners to bulkheads, all rivets to outside planting, rivets for coal bunker bulkheads, main and guard deck stringers and tie plates to beams, and all other rivets in auxiliary foundation to be 3-4 inch diameter and 5-inch center to center, except where water-tight calking is required. The rest of the deck plating to have 5-8 inch rivets countersunk on top. Water-tight bulkheads to frames and floors, also water-tight collars around keelsons, to have 3-4 inch diameter rivets spaced 3-inch center to center. Rivets in laps of butts of water-tight bulkheads to be 5-8 inch diameter, spaced 2 1-2-inch center to center. Main deck stringer-angle bar 3-4 inch rivets, 3-inch center to center, zigzag riveted through the 5-inch flange to sheer strake. Other riveting to be generally 5-8 inch diameter.

The butts of all keelson angles, stringer angles, and ridge bars are to be connected with angle-scarphing pieces not less than 4 rivets in each flange on each side of the butt. In all internal water-tight work not otherwise mentioned, the rivets are to be spaced 4 diameters center to center. The holes in the deck plating and center and side-house plating for rivets are to be countersunk. Centers of rivets are to be not less than 1 5-8 times their diameter from the edge of plate or bar.

All the water-tight work is to be properly chipped and thoroughly calked.

The rudders are to be of the balanced type, each with cast steel frame and separate wrought steel stock 10 inches in diameter. The stock is to have a turned shoulder at the support to take the weight of the rudder and a wrought iron eye bolt tapped into the top. The lower end of the stock will have a strong coupling of six bolts and be slotted to fit a feather cast on the coupling on the rudder frame. The rudder frame to be rabbited on the outboard section to receive the plating. The stock in the rudder frame will be 9-inch diameter at the head tapered to 6 inches diameter at the heel, and the cross bars of the frame will be tapered from the sizes of the outboard to the full thickness of the stock.

A socket is to be made in the rudder frame for the locking pin. Suitable castings are to be fitted in the deck over the rudder head and for the gag pin. A wrought iron spare tiller also to be fitted to each rudder.

The balanced part of the rudder will be cast solid, the spaces in the frame to be filled in solid with white pine and run with rosin. The side plates to be 15 pounds per square foot, each size in one piece.

The rudder will be supported inside the hull by means of a collar casting working on a heavy composition disk, which will be supported by a structure built in the hull, as shown on plans.

The quadrants for the rudder are of forged steel and the locking device will consists of wrought steel locking pins provided for the rudders proper and a special device operated from the pilot house for locking the quadrants. There will be both steam and hand steering gear, the steam steering engine being a type equal to a 6 by 6-inch Williamson engine. Each steering engine is located at the opposite end of boat from the rudder which it operates.

The fresh water tanks are about 14 feet long, 6-feet diameter, and are located as shown on the plans. On each side of the boat there will be thirty side lights 10 inches diameter.

(To be continued.)

Launch of the Milwaukee.

The *Milwaukee*, a 22-knot protected cruiser of 9,700 tons displacement, was successfully launched from the Union Iron Works, San Francisco, Cal., September 10. The ship is 424 feet long on the load-water line, 66 feet extreme breadth, and 22 feet 6 inches normal draft. Her launching weight was about 5,000 tons. On board were the tubes for all boilers, erected in position, also line and propeller shafting, but no propellers—the shafts being protected by cast iron caps.

The ship's stern touched water at high tide. The ways were built of 12 by 18-inch timbers, four slabs being used. From center to center of the inside timbers was 25 feet 2 inches, and the space between them and the outside ways was 12 feet. Throughout their length they had a camber of 9 inches. The two anchor chains belonging to the boat were used to check her after launching; from anchors embedded in the mud the chains ran to eyes riveted to the ship's side. At five points on each chain the chain was looped in bights, and tied with 5 turns of 3-inch rope, the strain to break each being 30 tons.

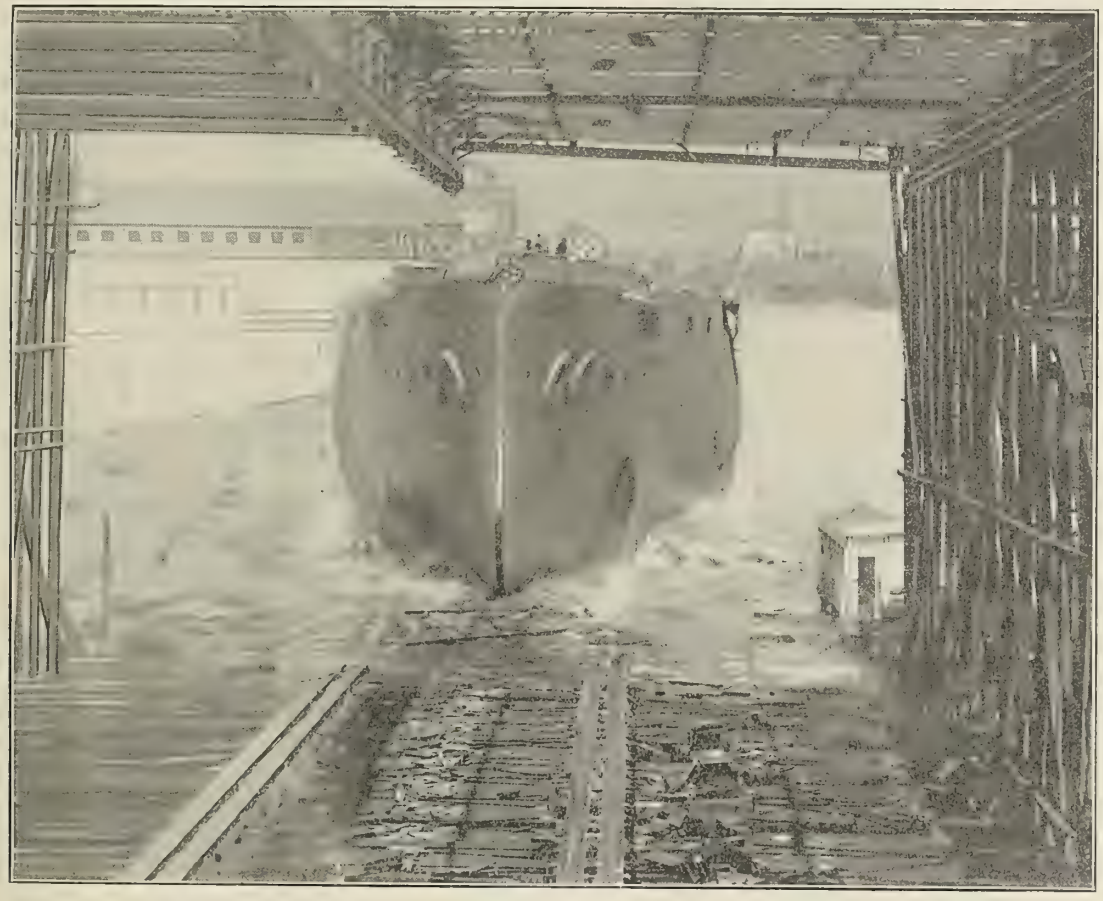
The following gives the general data of the launching:

Launching weight of hull	about 5,000 tons.
Length of ground ways, fore puppet to aft end	409 ft. 0 ins.
Distance of rudder pintals to aft end	51 ft. 0 ins.
Distance fwd. perp. to center of poppet	54 ft. 0 ins.
Length of cradle fwd. side of fore poppet to aft side of aft poppet	323 ft. 0 ins.
Width of ground ways	36 ins.
Thickness of ground ways	10 ins.
Width of sliding ways	36 ins.
Thickness of sliding ways 8 ins., after two pieces	10 ins.
Effective width of sliding ways	16 3-4 + 17 1-4 = 34 ins.
Effective area of sliding ways	1,828 sq. ft.
Pressure on ways per sq. ft. surf	5,492 lbs.
Inclination of keel of vessel	1 in 26
Spread of ground ways	25 ft. 2 ins.
Height of keel above ground ways at fwd. poppet	4 5-8 ins.

Minimum height of keel (frame 42)	1 3-4 ins.
Height of keel above ground ways at aft poppet	2 ft. 9 1-4 ins.
Depth of water at end of ways	11 ft.
Number of packing wedges	172
Width of packing wedges	12 ins.
Length of back dog shores	5 ft. 6 ins.
Size of iron back dog shores	9 by 10 ins.
Size of nip shores	6 by 9 ins.
Angle on end of dog shore	1 in 5
Pressure on dog shore neglecting friction	200 tons
Estimated weight of cradle	200 tons
Total blocks and shores while building	233
Distance of stopping plate from fwd. poppet 8 ft. fwd. frame	39
Distance below armor shelf	2 ft. 9 ins.

and a total heating surface of 64,000 square feet. The Howden forced-draft system is used, air being supplied by 16 compound blower engines running at 800 revolutions. There will be four smoke pipes, with four uptakes each, and air heaters complete. A very complete outfit of pumps is installed with cross connections for interchangeable duties in case of emergency. Other auxiliaries include ash hoists, turning engines, ice machinery, work shop, distilling plant, ventilation system, and other minor auxiliaries, including a very complete equipment of electric ammunition hoists.

The main battery consists of fourteen 6-inch breech-



THE UNITED STATES CRUISER MILWAUKEE TAKING THE WATER AT SAN FRANCISCO, SEPTEMBER 10.

The lubricant consisted of a private formula for combining tallow.

The two sets of main engines of the *Milwaukee* are of the usual four-cylinder, triple-expansion type, 36, 59 1-2, 69, and 69 by 54 inches stroke. At 133 revolutions they are expected to develop 21,000 I. H. P., sufficient to drive the ship at 22 knots. Steam is carried at 250 pounds per square inch. Both engines turn outboard. Each condenser has 13,400 square feet of cooling surface, and a 21-inch centrifugal circulating pump and compound engine. Two auxiliary condensers for engine rooms have 600 square feet of cooling surface each. The dynamo room condenser has 1,200 square feet of cooling surface.

The steam is furnished by 16 Babcock & Wilcox boilers having a total grate surface of 1,400 square feet

loading R. F. rifles of 50 calibers in length. The secondary battery includes eighteen 3-inch (14 pounders) breech-loading rifles of 50 calibers in length, twelve 3-pounder semi-automatic guns, four 1-pounder automatic guns, eight 1-pounder R. F. guns, two 3-inch field guns, two machine guns, .30 caliber, and eight automatic guns, .30 caliber. An armor belt 4 inches thick is worked in amidships while a protective deck, 3 inches on the slopes and 2 inches on the flat, extends the entire length.

In the central electric station are two 100 Kw. and three 50 Kw. generators furnishing current at 125 volts for 1,000-odd lamps, twelve arc lamps, six 30-inch search lights, fans, electric whistle, etc. The ship will be steered by steam and fully equipped with telephones, speaking tubes, signal, and general alarm systems, and a wireless telegraph equipment.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

The attention of subscribers is called to our change of address, beginning with October 1, to the Whitehall building, 17 Battery Place, New York, N. Y. We make the change in order to occupy larger and much finer quarters in a building facing Battery Park, at the lower end of the city, in a district that is closely identified with shipping interests. We invite our friends and subscribers to call upon us at our new offices, where we trust to continue and strengthen the acquaintances that have been formed at our former address.

BECAUSE of the well-understood limits of weight within which the marine engineer must work in powering a ship, he should ever be on the watch for new and improved apparatus whereby the weight of machinery or necessary bunker coal to be carried may be decreased. So far-reaching would be the results therefrom of such device, that the field of investigation is crowded with not only the able investigator, but unfortunately with the crazy inventor, as attested by the hundreds of worthless patents annually taken out on propelling mechanisms.

At the present day the screw propeller is more firmly established, through severe trials in all class of work, than ever before, regardless of said revolutionary inventions, and it is to improvements in the motor itself that the future economy will apparently result. Until of recent years the exclusive type has been the steam engine, and the strides made by the multiple-expansion over former engines are most remarkable, especially when one considers how recent their general adoption is. The introduction of the steam turbine is a most conspicuous mile-stone in steam engineering, and, while at present its precise value to the marine branch of engineering is not determined, it is doubtless destined to play a most important part in the future. With it has returned the steam super-heater, of different form but the same in principle as its little-used antiquated predecessor of forty years ago, and also an appreciation of the advantages of a high vacuum. Recent tests carried out abroad on a stationary multiple-cylinder engine show that these two conditions of superheat and high vacuum produce almost as striking improved economy in the steam engine as in the steam turbine.

However efficient may be the type of steam motor, and however serviceable and reliable it may have proved to be, it is at best an expensive machine; the conversion of the energy in the coal to the kinetic energy of the revolving shaft is too indirect. The ideal motor is one where the entire transformation takes place in the motor itself, without the intervention of a boiler or generator. Of this class the gas engine is the most approved type, and the astonishing rapidity with which it has been adopted by vessel owners, in more or less efficient forms, not only proves its adaptability to this field, but the fact that the owners are anxious and ready to take up an improved form of motor. Each year records larger sizes of gas engines installed on pleasure and merchant craft, and when certain engineering and manufacturing problems have been solved we may expect to see this type fitted in the larger vessels. One restriction to the use of large-size gas engines on shipboard has been the high price of fuel, generally gasoline, as compared with coal. While the world's coal supply is, in fact, diminishing, the rate is so small that those of this and following generations need feel little alarm that their supply will be cut off, and they can look to coal

as their principal source of power. For several years large-powered gas engines have been run at low cost, on coal gas, where the price of coal is low, and of recent years many gas plants have been built for the sole purpose of supplying power to engines of this type. Notable economic results are obtained in many such plants, and a record of one indicated horse power on three-quarters of a pound of coal is by no means exceptional. In all such plants the size of the gas generator and cleanser has prohibited the use of this system for marine purposes, but of late its advantages have attracted marine engineers to modifying the design to their particular requirements. The result is that abroad several types are being experimented with for propelling barges and other small merchant craft, and on another page of this magazine will be found a general discussion of the requirements and method of carrying out such a design.

Other lines of research that at present indicate promising results and in which some of the leading scientists and engineers are seriously engaged, are with the gas turbine and the coal-electric cell. To combine the advantages of high speed, light weight, rotating instead of reciprocation motion possessed by the turbine with the direct heat conversion and high thermodynamic efficiency of the gas engine would result in an almost ideal motor, and the theoretical solution of the problem is not strewn with the difficulties such as lie in the path of the practical one. As soon as an efficient method for burning a gas in a generator under high pressure is developed, we may expect to have the gas turbine. To transform the energy in coal directly into electricity is the task of another set of tireless researchers. For many years the well-known properties of the thermopile have indicated to the men of physical science the close analogy between heat and electricity and the possibilities of a direct conversion of one into the other.

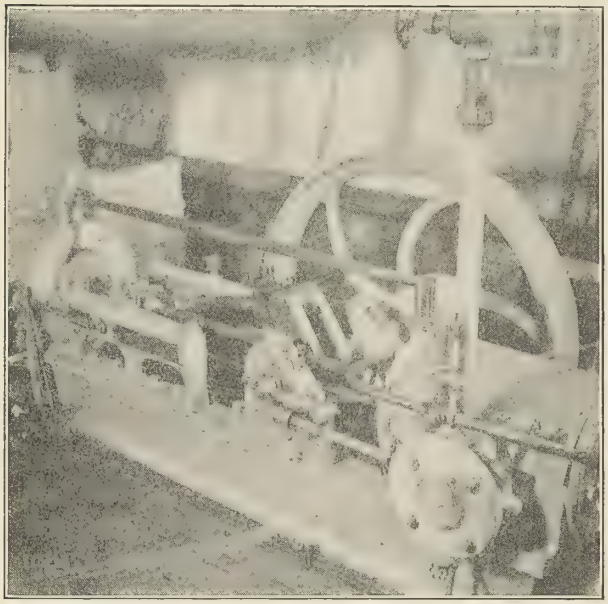
While thus reviewing the lines of research and development in the method of producing motion, we would not for a moment have our readers imagine that we are recommending the abandonment of the faithful steam engine for a new and undeveloped type of motor, but rather that we are calling attention to the possibilities of the future.

THOROUGHNESS is as much a characteristic of German technical education as it is of manufacturing or other German pursuits. Under the patronage of the government a system of technical schools called technikum has been established in the principal manufacturing centers. The technikum, which is a composite institution, aims to especially teach those trades which flourish in the locality in which a school is situated; thus the school at Bremen deals chiefly with shipbuilding and engineering. On another page will be found a report from the United States deputy consul at Chemnitz, upon the German marine engineering and navigation schools. This report is one of a series of most valuable documents on the industrial education in that country submitted to the state department. Many years ago the German emperor, realizing the necessity of educating competent navigators and shipbuilders in order to attain his ideals of commercial supremacy as a naval power, established a thorough school system, and it is largely to this that the rapid development of the German navy and merchant marine may be ascribed. Preparatory schools admit the student at an early age and fit him to undertake the advance courses of the technikum. Throughout, the study is along the most practical lines, as indicated in the curriculum given of the naval engineering course. There are also courses for pilots and captains, machinists and engineers, engine draftsmen and naval constructors, and with all is required considerable practical experience. Our own system of technical education differs considerably from that extant in Germany; in the first place none of our schools are supported directly by the national government, and technical work is not attempted until the student has reached a more advanced age. While the ultimate relative value of the two systems cannot be stated, there are many points to commend in the German method.

IT is to be hoped that the final chapter in the affairs of the United States Shipbuilding Company, whereby the constituent plants have been sold by the receiver at public auction, will restore public confidence in shipbuilding regardless of certain high financiers who organized the fraudulent trust. To be sure, each plant was bought in by the reorganization committee of the bond holders, but upon a basis where it may be run as a profit-making concern. No one will regret the death of that trust, the last of the billion-dollar fancies, and all will wish the new comer success as it gathers together the frayed garments of its predecessor to establish itself as a strong shipbuilding company.

Setting a Circulating Pump Valve by Indicator.

A Cameron pump, Fig. 1, has been serving as a circulating pump on board a steamer for about 30 years. Its capacity is so generous that it will do its work with ease, even when the seawater is warmest. The trouble has been to keep it turning slowly enough to maintain a vacuum that will give the desired high temperature in the hot well. In winter, with the temperature of the seawater near the freezing point, from 16 to 20 revolutions per minute would do this; but when a heavy sea happened to be running, the difference in the head of water between the top and the hollow of the seas, as they washed along the ship's side, made the pump very liable to stop on the after or crank center.



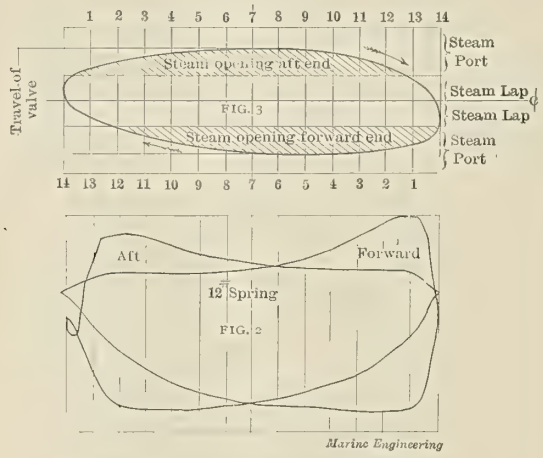
(AFTER END.)

FIG. 1, THE CIRCULATING PUMP.

As the engineer on watch had other things to attend to, besides standing by to put his shoulder to the wheel to help out his circulator, and yet he did not care to run the machine too fast, thereby increasing the coal consumption, he looked for the cause of this trouble and found: Plain slide valve, 1 1-16 inch travel, 1-4 inch steam lap, 7-32 inch exhaust lap and 1-8 inch negative lead. Evidently the steam had a hard time, both in getting into and out of the cylinder. Giving more lead aft, only made matters worse by reducing the already small steam pump on the forward end. A 25-pound weight on the rim of the flywheel counterbalanced the crank so that it would carry over the centers, and thus the pump was run at slow gait, until the engineer found time to fit an indicator to the cylinder. The card is shown in Fig. 2.

While a card of this sort ought to be quite sufficient data for an engineer experienced with the indicator to prescribe the changes necessary to improve the steam distribution, yet a much clearer insight was gained by mounting the indicator with the drum parallel and close to the valve stem, so that a pencil fastened to the latter would draw a line on the card, while the drum was worked from the same reducing motion as used for the ordinary cards. The accompanying diagrams, Figs. 3, 5 and 6, were drawn with this arrangement. The indicator was easily fastened horizontally in the main bearing oilcup hole, by way of a 45-degree ell. Indicator piston and pencil levers were removed as unnecessary for this operation. The card was taken by the pencil attached to the valve stem, after which the pump was stopped, and with the pencil stationary the drum was pulled around by hand and a base line drawn on the card. A little reflection will soon make clear that a diagram obtained in this manner shows the true relative positions of the valve and the piston at any point of the stroke.

The angularity of the short connecting rod (24 inches long to 14 inches stroke) in this case caused unequal steam admission at the two cylinder ends, as shown on the card, Fig. 2. Any analysis of the steam distribution not taking the angularity into consideration would not reveal the true state of affairs; on this diagram it is seen at a glance. The pointed shape of the ellipse at the after end of the stroke tells the story better than



FIGS. 2 AND 3, THE CARD FIRST TAKEN.

words can do of the slow motion of the valve at that point, as compared to the well-rounded curve forward.

Now, in regard to laying off the steam-parts on the diagram. A centerline was drawn parallel to the base-line through the center of the vertical height of the ellipse. With the valve placed central over the steam-ports we know that the lap is measured from the edges of the valve to the edges of the ports. The travel of the valve at any point of the stroke is measured by the height of the ellipse above or below the center line at that point, so when this point is on the center line a movement in either direction equal to the lap will, of course, uncover the port. Therefore, mark off the amount of the lap from the center line on both sides, draw lines through these points, and from these lay off the widths of the steamports. The vertical distance between the lap line and the ellipse will then be a measure of the valve opening; and the junction of the two lines will give the exact points at which admission and cut-off take place. How nicely this is shown is seen by comparing Fig. 3 with cylinder card, Fig. 2.

To avoid confusion it is well to keep in mind that the valve, when traveling forward from the center, opens the *after* steamport, while when it is going aft it is admitting steam to the *forward* end of the cylinder. After the foregoing it is only necessary to add in explanation to diagram Fig. 3, that with an exhaust lap only 1-32 inch less than the steam lap the steam had to escape through practically the same opening through

FIG. 4, STEAM CHEST CARD.

which it entered the cylinder. This, in connection with the late opening, accounts for the high back pressure lines in Fig. 2.

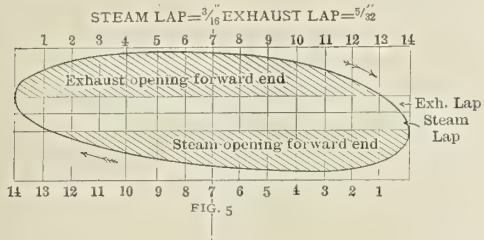

STEAM LAP=3/16" EXHAUST LAP=5/32"
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Exhaust opening forward end
Exh. Lap
Steam Lap
Steam opening forward end
14 13 12 11 10 9 8 7 6 5 4 3 2 1

FIG. 5

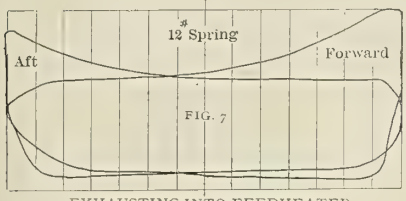


FIG. 7

EXHAUSTING INTO FEEDHEATER

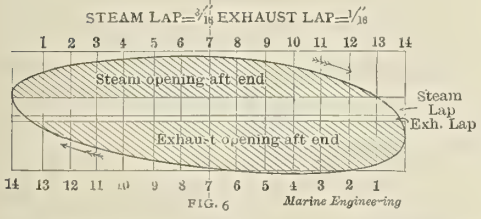

STEAM LAP=3/16" EXHAUST LAP=1/16"
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Steam opening aft end
Steam Lap
Exh. Lap
Exhaust opening aft end
14 13 12 11 10 9 8 7 6 5 4 3 2 1
Marine Engineering

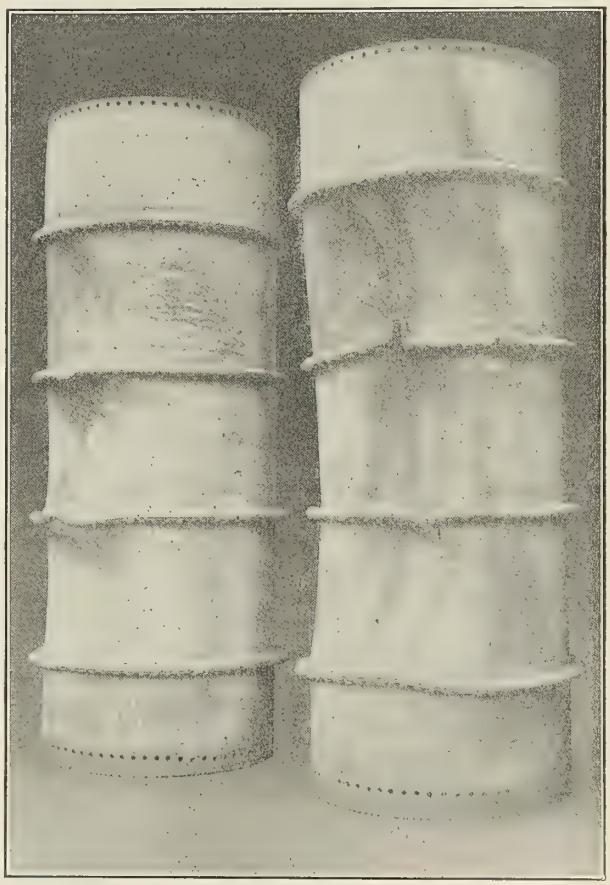
FIG. 6

FIGS. 5, 6 AND 7, THE CARD AFTER CHANGES.

Thirty years of wear on the eccentric pin had moved its center considerably out from its original place, affecting the angle of advance and the throw. To illustrate how both of these factors have been reduced through most of the wear taking place on one side of the pin, a steamchest card is reproduced in Fig. 4. The throttle was kept only partly open, which explains the great variation in the pressure in the steamchest, and also the drop of the steam line in the cylinder card. At the ends of the piston stroke, when the pressure in the chest is highest and the work of moving the valve hardest, the eccentric pin is ahead of the vertical center line of the crankshaft to the amount of the angular advance. Examination of the pin showed that it was worn straight back from the direction in which it was driving. Another thing to be noted on this card is the additional evidence of the rapid movement of the valve at the forward end of the stroke by the sudden rise and fall of the pressure on that end.

The changes made before the final diagrams were taken consisted in cutting away some of the steam and exhaust lap on the valve, and placing a new pin with 1-8 inch longer travel and with enough angular advance to give a little lead. Separate diagrams are given for each end, on account of the difference in the exhaust lap. The first setting with 1-16 inch exhaust lap at forward end gave no compression, so the change was made to 5-32 inch at the sacrifice of a free exhaust.

Some engineers in sizing up a pair of cards like Fig. 7 would probably endeavor to further improve on them, to balance up the two ends, but after studying the peculiarities of the gear with the help of these diagrams they would surely see the futility of expecting to produce perfect cards from the job. This method of analyzing the valve movement would be equally valuable for up-to-date machinery. O. O.



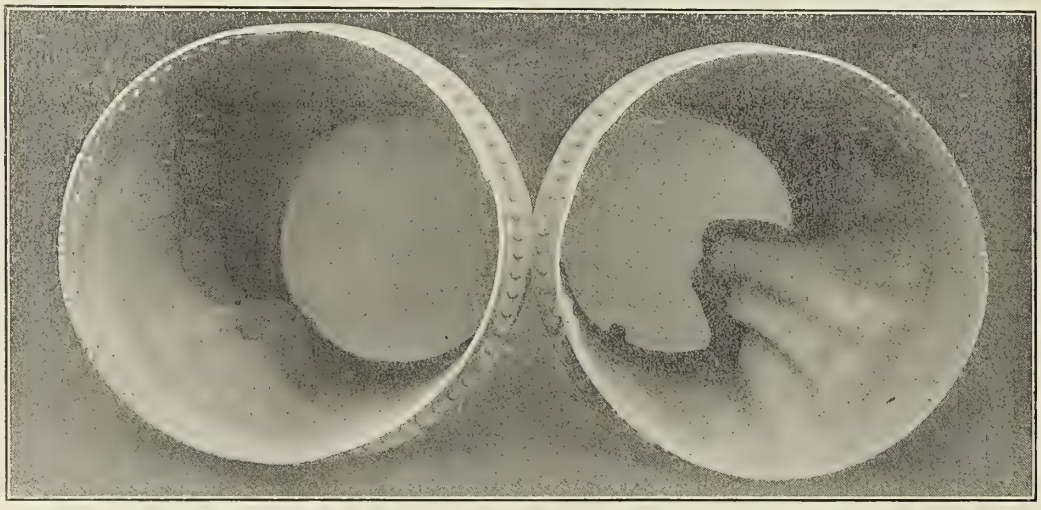
TWO FURNACES COLLAPSED BY OIL DEPOSIT.

Collapse of Furnaces.

The two furnaces illustrated herewith were taken out of the steamer *Majestic* on Lake Michigan, after collapsing under most unusual conditions. The furnaces were in the port boiler of the steamer, and the accident occurred two hours after leaving port on the first trip this season. The boat had been laid up during the

winter near a gas-light plant, and it is surmised that the river water, which was used for filling the boilers, contained a large amount of accumulated tar or oil. The furnace with a large bulge came down enough to break four grate bars, and was ruptured at the lowest point. Fortunatetly the aperture extended toward the rear, and the water blowing down was discharged into the back connection and thence through the tubes and uptakes. If the aperture had been in the opposite direction the fireman would probably have been seriously, if not fatally, burned and scalded, for the fire doors would have been blown open and the fire and steam blown out into the stokehold.

The furnaces were 44 inches diameter, 10 feet long and 47-100 inch thick. They had been in service but two seasons of nine months each. Inspection showed that there was no great or excessive amount of scale on either furnace, but the line streaks on the outside surface, and seen in the photographs, indicate that sediment or oil was the cause of the falling down. Satisfactory proof as to whether or not the water was low has not been forthcoming. The two new furnaces were replaced in four weeks by the Sheriffs Manufacturing Company of Milwaukee, to whom we are indebted for the above facts. The accident also made it necessary to replace ten of the 144 4-inch boiler tubes.



INSIDE VIEW OF FURNACES TAKEN FROM THE MAJESTIC.

Lubricating Oils and Their Properties.

In a recent number of *Power* is published an article on lubricating oils and their method of manufacture and testing, written by Mr. William M. Davis, from which following extracts are made:

Lubricating oils such as are used in engineering practice are a product of crude petroleum. The oil as it comes from the well is usually a thin, oily fluid, ranging from pale yellow to dark green and sometimes black in color, having a very offensive odor, very volatile and inflammable. This crude oil after being pumped through pipe lines, perhaps for hundreds of miles, to the refinery, is run into stills, where it is subjected to heat, first by steam and the lighter or most volatile vapors are thrown off, and, passing through condensing coils surrounded with cold water, are condensed in the form of a fluid.

This first product of the still is called naphtha distillate, this is redistilled and treated chemically to form the various grades of gasolines and benzines; other products of naphtha distillate are known as cymogene, rhigoline and petroleum ether.

The oil remaining in the still is then subjected to a higher temperature and the various grades of burning or illuminating oil are thrown off; this distillate is retreated to form the 110-, the 130-, and the 150-degree flash test oil.

As the lighter products are distilled the oil remaining becomes more and more dense and less volatile till it becomes necessary to use a fire under the still. After the burning oils are taken off, the lighter grades of lubricating oils, such as neutral oils, and paraffine oil, are run off and condensed. These are known as distillates, and are re-treated with chemicals and by filtering so as to free them from impurities and clarify them.

The oil remaining in the still is subjected to a more intense heat, and as the process of distillation goes on, the heavier oils remaining in the still known as residual oils are drawn off, and used to make the various grades of light and heavy engine and machinery oils; these oils carry with them a certain amount of paraffine wax which is separated by running the oil into tanks and subjecting it to a refrigerating process by means of which the wax congeals and settles in the bottom of the tanks. The oil, after being freed from the wax, is run off, the wax is taken out and retreated so as to form the ordinary wax of commerce which is used principally in making candles. It is also used for insulating purposes.

After the various grades of engine and machinery oil are drawn from the still, the remaining oil is subjected to a still higher temperature and when taken out it is known as cylinder stock, which is filtered and compounded with various animal or vegetable oils in order to make it into the various grades of cylinder oil.

These oils will vary in their color and quality according to the crude they were made from and the process used in making them.

All lubricating oils are known by certain properties, or tests, as they are sometimes called, and are used by refiners and dealers in grading and classifying the oils, and sometimes by large consumers in buying oil.

The properties are known as gravity, flash test, fire or burning test, viscosity, cold test, and evaporation test. These properties do not always indicate the lubricating value of an oil, but are of great value in detecting adulterations in oils.

In speaking of the specific gravity of an oil, we mean its weight as compared with an equal volume of water at its point of greatest density, or 39.2 degrees Fahr. At this temperature a cubic foot of distilled water weighs 62.42 pounds, but it is usually taken as 62.5.

To find the specific gravity of an oil we divide its weight by the weight of an equal volume of water. For instance, we know that a certain oil weighs 53.5 pounds per cubic foot, then $\frac{53.5}{62.5} = .856$ specific gravity. As it is not always convenient to weigh the liquids, the density or comparative weight of the oil is obtained by means of an instrument called a hydrometer. This instrument consists of a glass tube containing a graduated scale, the lower end of the tube terminating in a bulb filled with lead shot or with mercury, the amount of which is such that when the hydrometer is immersed in water it will sink to the point marked 10 on the scale. It will sink below or rise above the 10 mark according as the liquid is lighter or heavier than water. Lubricating oils being, of course, lighter than water, the hydrometer will sink below the 10 mark, and the readings on the scale show the specific gravity.

In the oil trade, however, the instrument in most general use is the Baumé hydrometer. This instrument is so graduated that it floats in water at 10. The graduations usually range from 10 to 40, and when we measure the weight of an oil with the Baumé hydrometer we speak of it as having a certain "gravity," not "specific gravity."

As all liquids expand with heat and contract with cold, the gravity of an oil will vary with the temperature. It is necessary therefore that observations be taken at some constant temperature or that an allowance be made for any departure therefrom.

The Baumé hydrometer is correct only at 60 degrees Fahr., and where it is not convenient to bring the temperature of the oil to this point, it is customary to add 1 degree to the hydrometer reading for every 10 degrees less than 60 degrees Fahr., and to subtract 1 degree for every 10 degrees that the oil is more than 60 degrees.

For instance, if the hydrometer when immersed in an oil whose temperature is 50 degrees Fahr. shows a gravity of 27, its correct gravity would be 28. On the other hand, if the temperature of the oil when tested is 90 degrees Fahr. and the hydrometer stands at 27, the correct reading will be 24 gravity Baumé.

This method, while accurate enough for ordinary work, is not absolutely correct. Where greater accuracy is desired, the table in C. F. Tagliabue's *Manual for Inspectors of Coal Oil* can be used.

Some Baumé hydrometers have a thermometer attached, and some have the specific gravity marked on the scale; but where the specific gravity is not given it can be determined by the formula $\frac{140}{130 + \text{gr. Baumé.}}$ For instance, the hydrometer shows a gravity Baumé of 27; then $\frac{140}{130+27} = \frac{140}{157} = .8917$ specific gravity.

Tugboat Arabs.

Accompanying engraving was taken of the wooden tub-boat *Arabs,* recently built for the Pacific Mail Steamship Company, by the Fulton Iron Works, San Francisco. The boat went through a successful trial trip developing 900 I. H. P., and running at a speed of 12 knots. The general dimensions of the *Arabs* are as follows: length over all, 115 feet; beam molded, 24 feet; depth molded, 12 feet.

The hull is built of pine; frames are spaced 25 inches, sided 8 inches; the ceilings are 3 inches at the floors, 6 inches at bilge and 4 inches above bilge; the planking is 3 1-2 inches thick. The stem, rudder post and rudder stock are built of oak.

The captain and chief engineer's state rooms, and forecastle with four berths, are below the main deck forward. The deck house contains a passenger cabin at the forward end with toilet adjoining, a stairway leading to the top of deck house, store rooms and toilet rooms, galley between the engine and boiler casings and mess room. The pilot house is fitted with combined seat and berth on one side and seat on the other. There is a steam and hand steering gear, the steam gear being operated by a 4 by 5-inch double engine. Two 20-foot metallic life boats are carried on top of deck house.

The main engine is the compound type with cylinders 20 and 42 inches diameter by 24 inches stroke. A Babcock & Wilcox boiler, fitted with three oil-burning furnaces supplies steam. An oil fuel tank of 6,000 gallons capacity is placed forward of the boiler-room bulkhead, while in engine room are placed two water tanks of 4,000 gallons combined capacity.

The auxiliaries include an independent circulating centrifugal pump with 6 by 6-inch engine, fire pumps, 10 by 6 by 10 inches; feed pumps, 6 by 4 by 6 inches; steam capstan, with double 5 by 7-inch engine, and electric lighting plant of 2 1-2 Kw. capacity.

Both hull and machinery are built by the Fulton Iron Works.

ENGINEERING SPECIALTIES.

Stoking Indicators for Timing the Firing of Furnaces.

There are doubtless but few sea-going engineers who have not realized the danger of relying too much upon the intelligence of the stoker for the regular firing of the boiler furnaces at stated fixed times. Any mechanical arrangement or method presenting the advantages of careful, systematic, and regular firing in such a way as to relieve the engineer of this portion of his numerous responsibilities, must surely be very welcome. With this object the Kilroy stoking indicators, which are now successfully at work on several warships, have been devised. It is claimed that this apparatus secures a maximum coal efficiency and a minimum of smoke production.

The system provides in one ship a number of stoking indicators, one for each stokehold, or row of boilers. The indicators ring a loud gong, and show the number

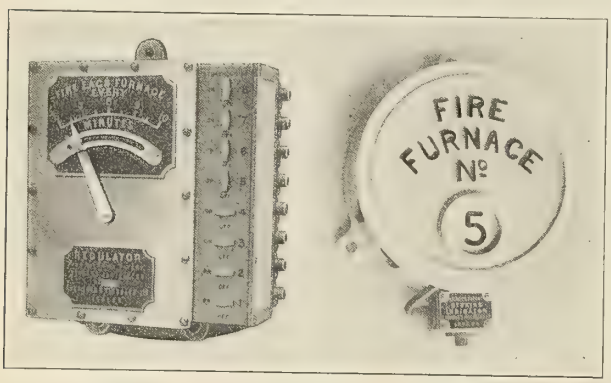


FIG. 1. FIG. 2.

REGULATOR AND INDICATOR FOR TIMING STOKING.

of furnaces to be fired, at the required intervals and in definite rotation, all the indicators being actuated electrically by one regulator or timing apparatus, conveniently placed in the engine room. The boiler furnaces, or, more strictly speaking, the furnace openings, should be numbered, preferably with brass numbers, as painted or chalked numbers are easily obliterated.

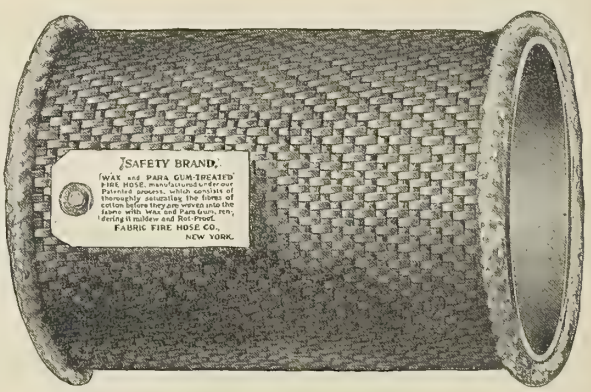
The regulator or timing apparatus consists of a special switch mechanism, which, at uniformly recurring intervals of time, closes electrical circuits, which actuate the indicators. This switch mechanism is so designed that but one indicator is rung at a time, calling for but one furnace door to be open at once in any group of boilers. A regulating lever is provided to enable the engineer to vary the rate of firing. For instance, if the regulator shown in Fig. 1 be set to an eight-minutes' interval, and supposing that there are eight furnace openings in a stokehold, the indicator will show a new number and ring a bell every minute; so that a complete rotation is obtained once in eight minutes. A set of switches is provided, one for each indicator, so that only those indicators which are required need be switched into gear. The apparatus is strong and water-tight, and when once switched into gear is automatically operated and requires no attention.

Each indicator consists of a strong outer case protecting the bell, and an inner water-tight case containing the electro-magnet and mechanism for moving the dial, which has numbers on it corresponding to the boiler furnace openings. When the current is passed round the electro-magnet one armature is attracted, so as to ring a single stroke on the bell, which is made water-tight in the same manner as an ordinary single-stroke admiralty-pattern bell. The other armature is attracted at the same time, and its motion serves to move the dial round to show the next number through the aperture in the front of the case; so that every time a furnace has to be fired a loud bell sounds and the number of the furnace appears. This number will remain visible until it is time to fire the next furnace. Fig. 2 gives a view of one of the indicators.

As a rough guide for determining the quantity of coal needed at each firing, the following may be taken as a typical case: assuming that each boiler is to be worked at an output of 450 I. H. P. and that the coal consumption is 2 pounds per I. H. P. per hour, then the coal burned per boiler will be 900 pounds per hour; and taking the weight of a shovelful of coal as 10 pounds, this is 90 shovelfuls in 60 minutes for each boiler. When 8 minutes has been decided upon as the firing interval, the number of shovelfuls required for firing to each boiler is therefore $\frac{90 \times 8}{60} = 12$. If each boiler has two furnace openings this will mean 6 shovelfuls to each furnace opening every time its corresponding number appears on the indicator. If each of these openings has two doors this will, of course, be 3 shovelfuls on each quarter of the whole furnace.

The advantages claimed for the apparatus, which is patented and made by Messrs. Evershed and Vignoles, Limited, Chiswick, London, W., are the following: (1) It is less complicated and much less delicate than a clock mechanism, if used for the same purpose. (2) It lends itself to being set at speeds varying over a large range without complication. (3) The forces used are larger, thus enabling a quick make-and-break switch of adequate proportions being brought automatically into action. (4) The current taken is very small, being only .6 ampere on an 80-volt vircuit; of this, .2 ampere go to work the regulator, and .4 ampere for the stoking indicators, when all the indicators are in use.

L. Ramakers.

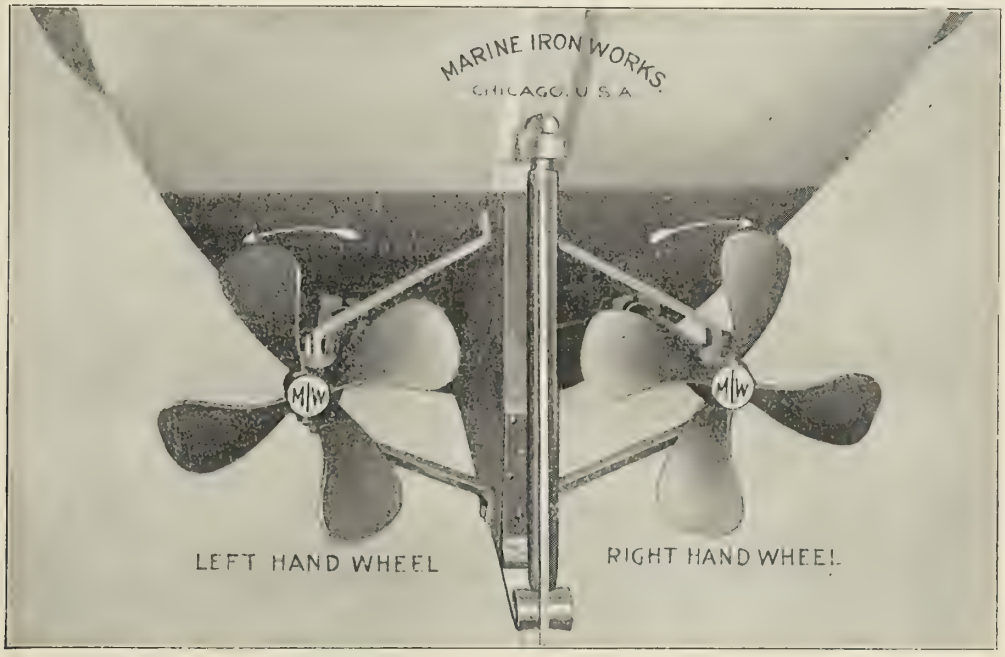


Safety Fire Hose.

Life and property are always endangered and often lost by too great dependence upon an inferior quality of

fire hose, yet it is probable that no article is so little understood and so carelessly purchased. It is just as criminal to sell trashy fire hose as it is to issue a false policy of insurance. The presence of hose in times of danger offers no protection against fire unless such hose is sold on the manufacturer's guarantee against mildew and rot. A plain cotton or linen hose is bound to absorb more or less moisture, not only when in service but from the atmosphere, which will sooner or later affect the life of the fabric. Not so, however, with wax and gum-treated cotton rubber-lined hose; murky and damp atmosphere has no effect upon it. Like a duck's plumage, no dampness finds a lodging there.

Over six million feet of Safety brand of fire hose manufactured by the Fabric Fire Hose Company, 68 Murray street, New York, N. Y., are now in actual service, and under the most severe tests are stated as giving universal satisfaction. The hose is sold under a guarantee that it is of superior quality, perfect in structure, and thoroughly tested as to strength and capacity. It is manufactured under letters patent protecting processes that render the hose mildew and rot proof, and with reasonable care practically indestructible. It is light to handle, strong, pliable, and a good water conductor. Life and property should not be heedlessly sacrificed when the means for their protection are always at hand.



DIRECTION OF TURNING PROPELLER WHEELS.

Propeller Wheels for Gasoline Engines.

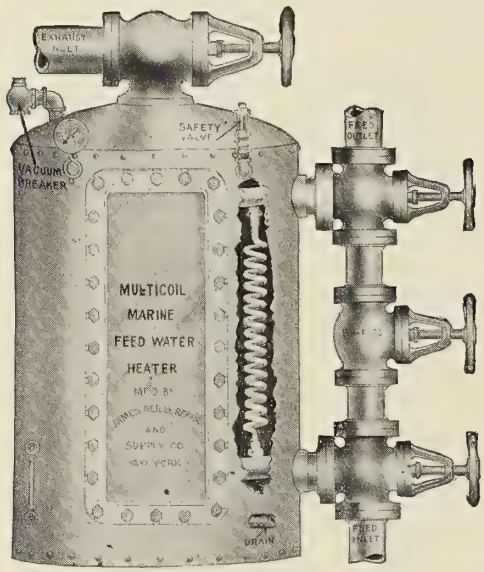
So many inquiries and orders for propeller wheels, not giving full and necessary particulars, have been received by the Marine Iron Works, Station A, Chicago, Ill., that the company has issued a circular with the above illustration, calling attention to the nomenclature of the direction of rotation of propeller wheels and other particulars. Many gasoline marine engines are made to revolve to the left when driving the boat ahead, and are known as left-handed engines; that is, if one stands behind the boat and looks ahead at the propeller, the top of the blade turns to port, or in the opposite direction to the hands of a clock. This left-hand turning is contrary to what is known as the standard propeller wheel for steam engines, which turns to the right. Therefore, in ordering a propeller it is of the utmost importance that the manufacturer be informed whether a left or right-hand wheel is desired.

The design of a speed propeller wheel for a gas engine is necessarily different from that of a steam engine. The former justifies a wheel suitable for a greater number of revolutions per minute than is required by a steam engine of the same power, and the degree of pitch therefore should be appreciably less. Besides, the directions of turning, the diameter, number of revolutions, speed of the boat, and whether the boat is to be used for towing or not should all be specified. The Marine Iron Works, which has supplied many launches in this country and abroad with propeller wheels from their patterns, calls attention to the fact that while the speed of a launch depends much upon the designs of propeller, it is impossible to drive a boat fast, even with a high-power engine, unless the hull is well formed.

Multi-Coil Marine Feed-Water Heater.

In order to increase the efficiency of marine engines the engineer has of late directed his attention to the conditions of operating the auxiliary machines, with most profitable results. These machines have for long escaped the careful attention of the designer, as they run but intermittently. However, when it is considered that they consume anywhere between 10 and 20 per cent. of the steam furnished by the boilers, it is evident what

an effect their economy has upon the efficiency of the plant. The exhaust from these auxiliaries, many of which must needs run when the main engine is at rest, has been led either into the atmosphere, second receiver, the condenser, or a feed heater of some type. Varying the back pressure of said exhaust will of course change the speed of the auxiliaries and require the attention of the engineer. For this reason it is inadvisable to carry the exhaust to the receiver or condenser. There are many objections to the open-heater type of feed-water heater, such as the length of piping necessary to connect said heater, which must be placed at considerable height above the feed pump, the deterioration of said pump due to the passage of hot feed water through it, and the necessity of having an extra lift pump to raise the water from the hot well to the heater. However, so desirable has it been found to heat the feed water above the temperature of the hot well that almost all engineers have installed some type of heater. The exact cause of

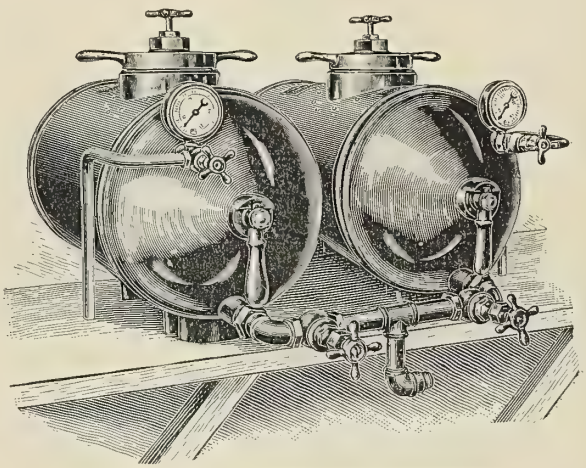


MARINE MULTI-COIL FEED WATER HEATER.

this increased economy of heating the feed water is, indeed, a subject of great interest at present, as the resulting increased efficiency is not as yet fully understood.

The multi-coil feed-water heater made by the James Reilly Repair and Supply Company, 229 West street, New York, N. Y., is one which is now being generally installed in all classes of vessels. It is a surface heater and may be placed between the feed pump and the boiler, thus requiring no extra pump as do the contact heaters. It consists of a cylindrical thin steel shell, with flat or bumped steel heads, and fitted with an annular gun-metal manifold at top and also one at the bottom, the two being connected by a series of helical copper coils by means of ground-joint unions. The feed inlet leads to bottom manifold and feed outlet leads from upper manifold. The auxiliary exhaust line is led to the top of the heater and the drain connection at bottom branches into pipes, one of which leads the condensation to the feed tank, the latter pipe being controlled by a valve in the smaller sizes or connected to a trap in the large sizes, and the other branch leads to the main engine, condenser, or atmosphere, and is fitted with an automatic relief valve which maintains a pressure of the exhaust in the heater shell. Under regular working conditions the feed water in the coils of the heater will absorb the heat of the auxiliary exhaust and discharge the condensation to the feed tank. In this manner the main condenser will be entirely relieved of the auxiliary exhaust. Slowing the feed pump will cause the feed water to pass through the coils at a slower rate, and the consequent diminution of the condensation of the auxiliary exhaust steam will cause the pressure to rise in the heater shell and the relief valve then passes the surplus exhaust to the condenser or atmosphere. For boats making long runs the heater can be connected to the valve chest of the L. P. cylinder of the main engine, maintaining a constant pressure in the auxiliary exhaust line and will assist the heater if the quantity of the auxiliary exhaust is not sufficient, or *vice versa*, a sudden surplus of auxiliary exhaust will go to the L. P. valve chest.

The multi-coil feed heater is found to condense all of the auxiliary exhaust steam in heating the feed water, requires only one feed pump, may be placed in the lower engine room in any convenient place near the feed line, is automatic in action and heats the feed water to a temperature of about 230 degrees when carrying 6 pounds back pressure. The apparatus is very light, as the shell and heads are of thin boiler plate tested to 50 pounds pressure, while the coils and manifolds are tested to 600 pounds or over if necessary.



STATIONARY TYPE OF DIGGS FIRE EXTINGUISHER.

Chemical Fire Extinguisher.

The Diggs fire extinguisher, herewith illustrated, is a handy and sure apparatus for using should fire break out on board ship. The chief points of this device are: first, that the acid is carried in a sealed bottle in an air-tight tank, and cannot be discharged by accident; by screwing the handle the acid is released at the top of the tank and pours upon the soda at the bottom. The fumes rising to the outlet at the top are a thoroughly mixed carbonioxide gas under light pressure, and will extinguish any flame on which they are directed. Second, one size of machine permits of easy handling; and,

third, the machine may be operated instantly by turning the handle of the screw in the cap which opens the acid bottle but does not break it. Thus no broken glass has to be removed for recharging the machine, which results in an important saving in the cost of chemical charges, as the machine requires no attention until it is

CHEMICAL FIRE-EXTINGUISHING HAND MACHINE.

called into requisition by a fire. The apparatus is made in many forms by the Diggs Fire Extinguisher Company, 141 Centre street, New York, N. Y.

PERSONAL.

Dr. Hans Goldschmidt, president of the Goldschmidt Thermal Company, has arrived in this country to address the International Electrical Congress at St. Louis on his invention, alumino-thermics.

Rear-Admiral George W. Melville, former Engineer-in-Chief, U. S. N., and John M. Macalpine, M. I. N. A., have opened offices at 615 Walnut street, Philadelphia, Pa., as consulting engineers and naval architects. Admiral Melville has recently returned from St. Louis, where he served as one of the jury of awards in the mining and metallurgy division of the World's fair.

Battleship Boilers.—Boilers for the battleships *Idaho* and *Mississippi,* building at the William Cramp & Sons' Ship and Engine Building Company, are to be of the Babcock & Wilcox type of 10,000 horse power and 8 units for each ship.

A Large Ore Carrier.—The American Shipbuilding Company, Cleveland, has recently received a contract from G. A. Tomlinson, Duluth, for a large ore carrier second in size only to one on the lakes. The new ship will be 6 feet long and 1 foot deeper than the *Sahara,* which is, next to the *Wolvin,* the largest carrier on the lakes. The vessel will be 500 feet over all, 480 feet keel, 52 feet beam, and 30 feet deep. She will have two Scotch boilers 13 feet 9 inches in diameter, and 11 1-2 feet long, fitted with Ellis and Eaves draft. She will have triple-expansion engines, cylinders 22 1-2, 36 and 60 inches diameter by 40-inch stroke. The vessel will have a hopper hold and numerous hatchways, like the *Wolvin,* but will have straight sides. The contract date for completion is April 15, 1905, and work will start at once.

QUERIES AND ANSWERS.

All reasonable questions concerning marine engineering received from and signed by subscribers will be answered by the editor in this column. All communications must bear the name and address of the writer.

Q. 248.—Would you kindly inform me, through your question column, if there is any rule, and how to figure the horse power of gasoline and kerosene motors, two and four-cycle, one or more cylinders? S. C.

A.—The power of a gasoline engine is determined by the same factors as in the steam engine, viz.: the mean effective pressure, *P,* acting upon the cylinder throughout the stroke, the length of stroke, *L,* in feet, the area of the piston, *A,* in square inches, and the number of power strokes per minute. The product of these four quantities divided by 33,000 will give the indicated horse power. The length of stroke and area of cylinder are determined from measurements on the engine. The number of power strokes in a single-cylinder, two-cycle engine is equal to the number of revolutions; while in a single-cylinder, four-cycle engine the number of power strokes equals half the revolutions. The uncertain quantity is the mean effective pressure, which may be obtained by the gas engine indicator card. In the absence of this, for rough calculation in the ordinary designed engine the value of 80 pounds is a close approximation.

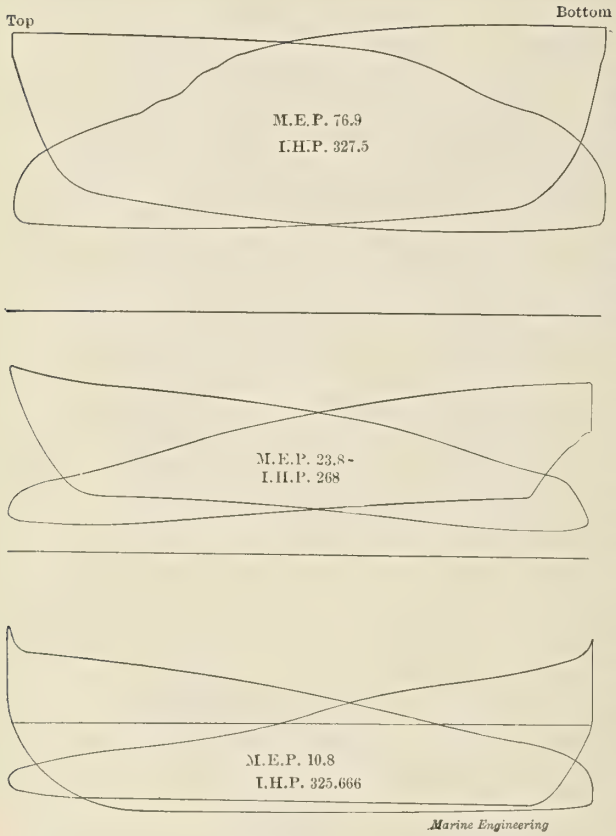
The above rules are for a single-cylinder engine. In a multi-cylinder engine, multiply the power thus obtained in one cylinder by the number of cylinders.

Q. 249.—How would you go to work to balance up the power in a triple-expansion engine, 20 1-4, 33, and 54 inches by 33 inches, which gives indicator cards as per the accompanying set, viz.: 327 1-2 I. H. P. in the high-pressures; 268 in the intermediate, and 326 in the low-pressure cylinder. The steam pressure at the boiler is 160 pounds gauge, the vacuum 25 inches, revolutions per minute 79. The connecting rods are twice the length of the stroke, the piston rods are 5 1-8 inches diameter. I cannot alter the expansion separately. The engine is solidly built with pumps working direct from the crossheads by arms both back and front. The indicator pipes are longer from the three-way cock to the bottom of the cylinder than from the top of the cylinder which, I think, accounts for the top card on the low-pressure showing a lower exhaust line.

A.—Generally speaking, to increase the work done by the intermediate cylinder, you should make the cut-off earlier in that cylinder. By thus doing you make a higher back pressure in the first receiver, thereby cutting down the power of the high-pressure and increasing the admission pressure to the intermediate. As seen on your card, the steam line to point of cut-off has considerable drop and said point of cut-off is quite indistinct; now, if you raise the admission pressure and cut-off earlier, the steam line will be higher, although the cut-off will be earlier, and the result gives a higher mean effective pressure.

As you state you cannot link in any of the cylinders separately, the way that you could shorten the cut-off would be to add to the steam lap of the valve.

It is quite usual to find the M. E. P. in the top card greater than in the lower. That is, more power is always developed in the top side of the cylinder, owing to the angularity of the connecting rod. A leak in the pipe connecting the indicator to the bottom of the low-pressure cylinder would naturally raise the exhaust line as said exhaust is below atmosphere.



ILLUSTRATING Q. 249.

Q. 250.—Will you kindly say through Q. and A. column if I can determine the capacity of a boiler by adjusting safety valves to allowable working pressure (in this instance 200 pounds), then weigh the feed water and see how much the boiler will evaporate under that pressure in a given time. Would this be a fair test?

What would be the approximate H. P. of twin-cylinder engine of the following dimensions: two-cylinder, 5-inch bore, 6 inches stroke; cut-off 5-8 of stroke; 200 pounds boiler pressure; 400 R. P. M.?

Would a propeller wheel 40 inches diameter, 60 inches pitch, be too large for above engine? I started with wheel 34 inches diameter, 54 inches pitch. Thus turned up about 400; then put on a wheel 38 by 55 inches pitch, and while the engine did not turn so fast the boat made better speed. I am now thinking of putting on a 40 by 60-inch wheel, unless you condemn it.

D. J. F.

A.—The method of making evaporation test, as you suggest, is correct. Of course you must record the temperature of feed water, and if the test is also to be for efficiency, the coal burned must be weighed. There are two methods of starting an efficiency test—one by drawing the fires just before the start and weighing all the coal that is put on, and ending by letting the fires burn down low; another is to make what is called a flying start; that is, have the fires in good shape, such as you wish to carry throughout the test, and conclude the test with the fires in the same shape; all the coal put on in the interim is to be weighed. The first method is to be preferred except in tests of many hours' duration. Another point to be observed is to mark the height of the water upon the glass gauge at the time of starting the test and bring the level to the same point when the test is ended.

By methods such as described in several previous questions (see the first part of the answer to Q. 429) the horse power of your two-cylinder engine, assuming that you are running it non-condensing and that there is a drop of 20 pounds from the boiler to steam-chest pressure, is 57 I. H. P.

Concerning the last part of your query on propeller wheels: you have omitted the essential data of speed and the dimensions of boat, so that we cannot answer intelligently. Assuming that you will drive your boat at 10 knots, we should say, roughly, that a wheel 40 inches diameter and 50 inches pitch would be about right. From the data in hand we would not advise you to have such a large pitch as 60 inches, else you will have very great slip and therefore an inefficient screw. Thus with the first propeller you tried, assuming that it drove the boat at a speed of 9 knots, the slip was over 50 per cent.

Q. 251.—How much power will it take to turn a three-blade propeller wheel, of usual pattern, 24 inches in diameter, 350 revolutions per minute? P. J. D.

A.—Power altogether depends on pitch, which ranges from 1 to 1.8 times the diameter of wheel. Assuming a pitch ratio of 1.3, the diameter would be 31.2 inches. The power also depends upon the speed of boat; assuming a speed of 8 1-2 miles, the power will be about 7 or 8 I. H. P.

Q. 254.—Will you please enlighten me in your next issue on how to read the air pressure as indicated on a U-tube air-pressure gauge such as is used to indicate pressure in fire room? *A* says that the difference in the two levels of water is read as inches of air; while *B* says that only one side is taken into consideration. Who is right, and why? Also, which is the more correct, a U-tube or a straight tube gauge? J. P. S.

A.—*A* is right, for the pressure head of water is always measured in difference of level; that is, the air pressure in the tube must be sufficient to support a column of water in height equal to the difference in level in the two tubes. The U-tube is the one to be preferred, in fact, is practically the only one used, for if a straight tube were substituted it would be impossible to retain the water in the tube.

Q. 256.—With reference to Question No. 243, in the September number of your magazine, would you please inform me in your next issue, if convenient, what amount of tube surface, or what number of tubes would be required in a surface condenser to suit the size engine specified in Question 243, supposing the injection water to be, say, about 60 degrees. L. W.

A.—The horse power estimated in Answer 243 is 26, and it is the custom to make the condenser surface, measured in square feet, about 1 1-2 times the indicated horse power. This would give a surface of about 40 square feet. In estimating the surface do not take in the area of the tube sheets, but only that of the outside of tubes. If keel condenser is used the surface should be increased to about 50 square feet.

New Fruit Steamer San Jose.

The entry of the *San Jose* into the Boston-Porto Rico service of the United Fruit Company is of particular interest from the fact that she is the largest fruiter in the United States trade, and is the first vessel to be equipped with refrigerating machinery in the Boston service.

The keel plate of the *San Jose* was laid at the ship yard of Workman, Clark & Company, Belfast, Ireland, about nine months ago. The fruit company contracted with these builders for the construction of three steamers of the same size, all for this trade. The *San Jose* was the first to be launched, and the two to follow shortly are the *Limon* and the *Esparta*. The general dimensions are: length between perpendiculars, 330 feet; length over all, 345 feet; breadth, molded, 44 feet 3 inches; depth of hold to the upper deck, 31 feet 3 inches. There are three complete steel decks, also topgallant, forecastle, and orlop decks of wood, the latter extending throughout the forward part of the vessel. The framing of the ship consists of angle irons to the entire exclusion of web frames, except in the engine and boiler spaces. She is provided with bilge keels to minimize the rolling motion, and is built with double bottom.

STEAMER SAN JOSE, THE NEW FRUIT STEAMER IN THE BOSTON TRADE.

Linde cool-air refrigerating machinery is installed. Each hold of the ship and between-deck spaces are insulated, and each space is fitted with air ducts through which chilled fresh air is forced. By this means low temperature may be maintained in tropical climates and the fruit landed in the north in the best possible condition. Each hatch is provided with the necessary steam winches and derricks and special appliances for the expeditious and careful handling of fruit cargoes. The vessel has a capacity of 45,000 bunches of bananas. The ship was constructed under the supervision of the British Corporation.

The machinery consists of a set of triple-expansion engines with all necessary auxiliaries. The dimensions of the engine and boilers are given in the data card.

At the forward end of the midship deck house is the passengers' dining saloon from which open state rooms on each side. The smoking room and additional state rooms are placed in the steel house on the promenade deck above. The accommodations for the officers are midships and the crew are berthed under the poop. The saloon is paneled in polished oak in a handsome manner and is furnished with sofas, revolving arm chairs, etc. The floor is covered with Brussels carpet, while the chairs and sofas are upholstered in moquette. The state rooms are finished in white enamel with comfortable sofas, running water, etc., and are all richly carpeted. The smoking room and other apartments are prettily furnished and the lavatories are finished in white enamel, with tiled flooring, etc.

This new fruiter calls attention to the evolution in this particular branch of our commerce. In 1870, Capt. Lorenzo D. Baker conceived the idea of bringing bananas to this port from Jamaica, and with the comparatively small schooner *Telegraph* he made his first venture in this trade. For several years schooners made occasional trips between Jamaica and this port, bringing small cargoes, which found a ready market here. In the early '80's the auxiliary steamers *Jesse Freeman* and *Lorenzo D. Baker* were placed in the trade, and later on these were followed by more modern boats, especially built for the trade. The business made phenomenal strides and at the present time the United Fruit Company own or have under charter a fleet of seventy-five steamers plying between their own plantations in Costa Rica, Colombia, San Domingo, Jamaica, and Cuba. Lines are operated to New Orleans, Mobile, Baltimore, Philadelphia, and this port, and the fleet includes some of the finest vessels in the West India trade.

Ice Breakers for Canada.—With a view to the maintenance of open water in the gulf and river St. Lawrence during the winter season, thus enabling the ports of Quebec and Montreal to compete with those of the United States for the entire year, the Canadian government has just placed with Fleming & Ferguson, Paisley, Scotland, an order for the construction of two large ice breakers. According to press notices, one of these vessels is to be a single-screw steamer of 800-tons capacity and capable of a speed of 11 knots. The other is to be a twin-screw steamer of 1,800 tons and able to make 17 knots.

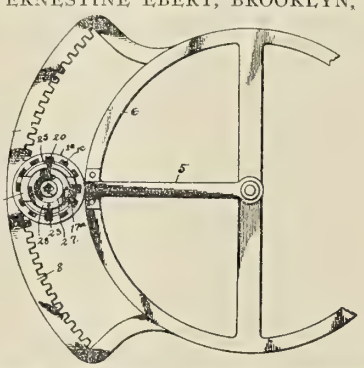
Lloyd's Reports of Lost Vessels.—Reports of vessels totally lost, condemned, etc., for the quarter ended December 31, 1903, have been issued by Lloyd's Register of British and Foreign Shipping. The total number of steam vessels wrecked for this quarter was 30, of 36,696 gross tons, while those burned, lost in collision, missing, etc., numbered 31, of 35,429 gross tons. One hundred and sixty-two sailing vessels, of 87,536 tons, were lost or condemned during this period. Of steam vessels the following were of American registry: the *Kiowa,* lost off Boston light; the *Ruth* and *South Portland,* lost on the Pacific. In all 23 American sailing ships were stricken from the registry during this period.

MARINE ENGINEERING DATA CARD. OCTOBER, 1904.

NAME—San Jose. NATIONALITY—British. TYPE—Freight steamer.

LAUNCHED—1904. BUILDER—Workman, Clark and Co. OWNER—United Fruit Company.

Length over all	345 ft. 0 ins.
" between perps	330 " 0 "
Breadth, molded	44 " 3 "
Depth to upper deck	31 " 3 "
Draft, load	22 " 0 "
Displacement, load	6,670 tons
Water ballast	500 "
Dead-weight carrying capacity	3,299 "
Engines: Number	two
Type	triple expansion
Cylinder diameters	25, 41, 68 ins.
Stroke	48 "
R. P. M. at sea	80
I. H. P. " "	2,750
Propeller: Diameter	16 ft.
Pitch	19 "
Boilers: Number	three
Type	single end Scotch
Working pressure	190 lbs.
Diameter	13 ft. 6 ins.
Length	11 " 6 "
Furnaces: Number	three each
G. S., total	150 sq. ft.
H. S., "	6,000 " "



SELECTED MARINE PATENTS.

765,431. TILLER LOCK. WILLIAM E. LEE, COLUMBUS, OHIO. Filed December 7, 1903. Serial No. 184,088. (No model.)

Claim.—1. In a tiller lock, the combination with a casing having a plurality of internal tooth recesses and means for supporting said casing from a vehicle frame, of a plate 10, supported in said casing, said plate having a spindle extension, means carried by said spindle for controlling the movement of the vehicle fifth wheel, spring-actuated overlapping sliding dogs within said casing and above said plate 10, a rotatable key body comprising a socket piece and key extension, the latter extending loosely through said dogs, and a ring plate connected with said plate 10, with which said dogs are adapted to contact when rotated. Two claims.

765,171. STEERING AND PROPELLING DEVICE FOR VESSELS. ERNESTINE EBERT, BROOKLYN, N. Y., ADMINISTRATRIX OF CARL VOGEL, DECEASED. Filed February 18, 1904. Serial No. 194,162. (No model.)

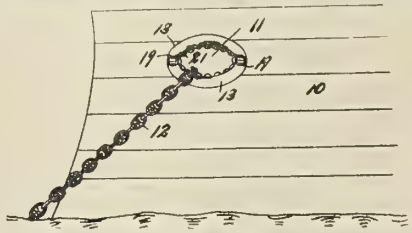
Claim.—1. The combination with the expulsion tube of a vessel or boat of a water-forcing means connected on its induction side with the water exterior to the boat and on its eduction side with the inboard end of said expulsion tube, and means for controlling the operation of said water-forcing means. Two claims.

765,373. BOW-FACING OAR. ARTHUR BERNIER, SALEM, MASS., ASSIGNOR BY DIRECT AND MESNE ASSIGNMENTS TO JOSEPH C. THIBAULT, LAWRENCE, MASS., AND THOMAS GAGNON, SALEM, MASS. Filed August 3, 1903. Serial No. 168,001. (No model.)

Claim.—1. In a bow-facing oar, a rocking member, oar and handle supporting members pivotally mounted at opposite ends on opposite ends of the rocking member, and a member connecting the oar and handle supporting members and having its opposite ends bent in opposite directions.

765,513. SHACKLE FOR MARINE PURPOSES. JASPER A. ROCK, SAN FRANCISCO, CAL. Filed November 11, 1903. Serial No. 180,667. (No model.)

Claim.—1. A shackle comprising a square bolt, a grooved sheave or roller having a square central aperture through which said bolt is passed, a forked hanger through which the arms of said bolt passes, said hanger having at its other end an eye for a hook and a shackle proper consisting of a bar extending around



the roller for the greater part of its circumference and in said groove, the ends of said bar being then extended parallel to but spaced from each other, and a tie bar passing through said ends.

765,933. HAWSE PIPE. GEORGE A. NOWLAND, ALEXANDRIA, VA., ASSIGNOR OF ONE-HALF TO AUGUSTUS H. AGNEW, ALEXANDRIA, VA. Filed March 28, 1904. Serial No. 200,458. (No model.)

Claim.—1. A hawse pipe comprising similar sections each having a body portion and a flanged rim, means for connecting said sections and means for securing said sections to the wall of the port, said pipe being provided with a series of anti-friction balls.

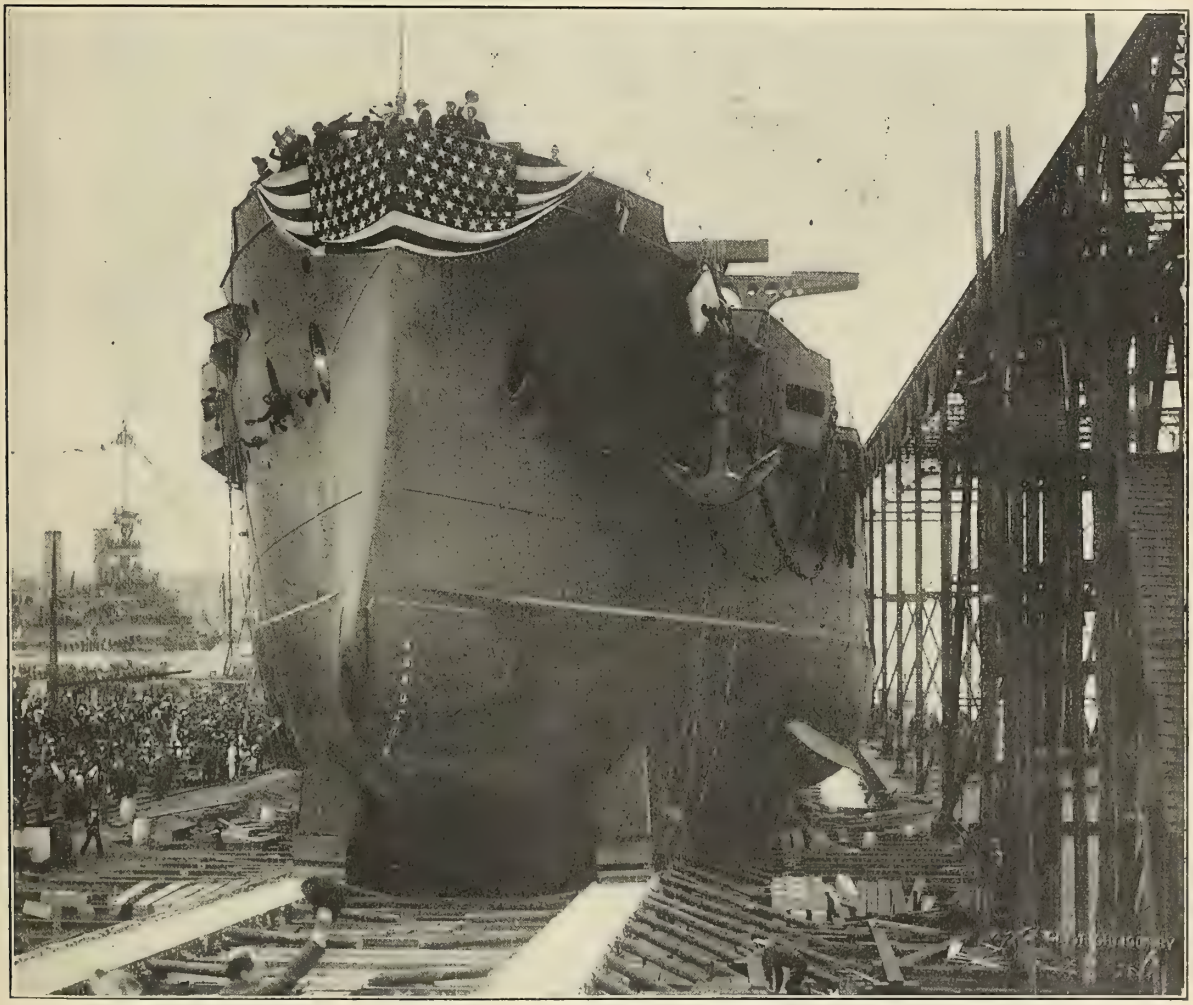
New Publications.—Twenty-ninth Annual Review of the *Daily Commercial News* of San Francisco is a complete and interesting review of Pacific-coast commerce for the fiscal year ending June, 1904. In addition to the usual statistics, are given illustrated articles describing the many ports of the Pacific coast, of value to those interested in commerce of this region.

Marine Engineering

Vol. IX. NOVEMBER, 1904. No. 11.

UNITED STATES BATTLESHIP CONNECTICUT LAUNCHED.

When the battleship *Connecticut* was floated in the East river from the Brooklyn Navy Yard on September 29 there was a very great feeling of relief on the part of those connected with the launching, as previous to the event three distinct attempts had been discovered to wreck this ship. The particulars were not given out until after the launch, and then Rear Admiral Frederick Rogers, commandant of the yard, stated that a person, or persons, evidently connected with the working force, had on two occasions bored holes in the hull plating, and the day before the launch a long spike was discovered on the under water portion of the ways. Any one of these three dastardly deeds might have caused serious damage to the ship; the first two by filling the hull with water and the last by ripping open the bottom plating.



THE BATTLESHIP CONNECTICUT SLIDING DOWN THE WAYS, AT THE BROOKLYN NAVY YARD, ON SEPTEMBER 29.

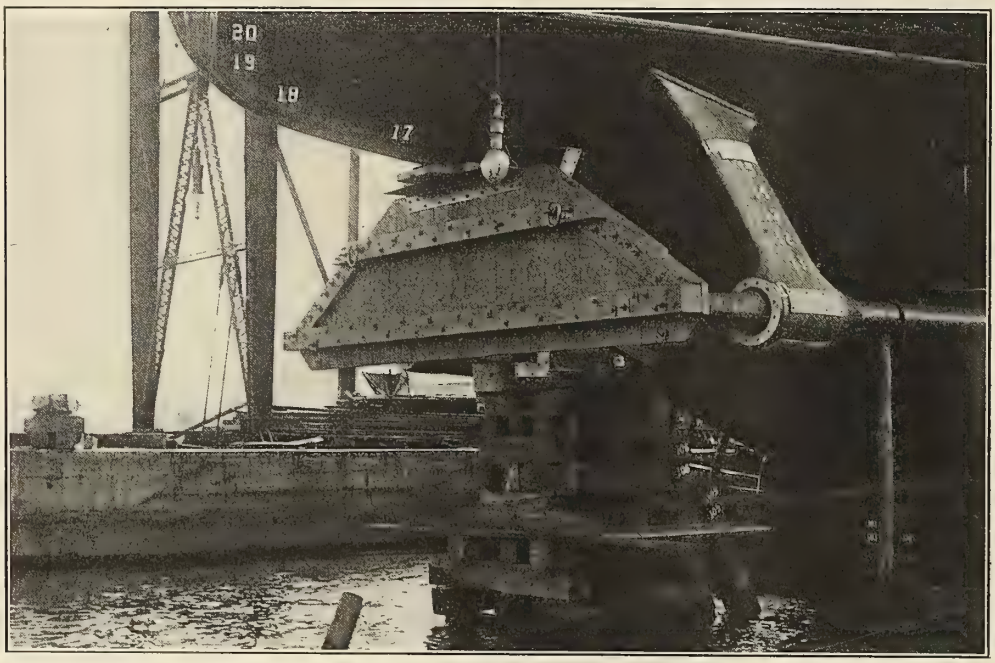
[Photograph, Copyright, 1904, by Hammett.]

A guard of marines had been placed about the battleship for several days previous to the launching, but the offenders were not detected. The commandant has issued a letter to the employees of the yard reviewing the incident and calling upon them to assist in detecting and convicting the guilty party.

(Copyright, 1902, by Marine Engineering, Inc., New York.)

Another unusual incident at this launch was that after the sponsor had failed to break the bottle of champagne, to be used in the christening, a sailor on deck pulled up the bottle by the cord with which it was, as is the custom, attached to the prow, and broke it after the vessel had started down the ways. The engraving on the first page was made from a photograph taken at this moment. A description and the principal dimensions of the *Connecticut* were given in the October number of Marine Engineering.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 105 sail and steam vessels of 14,699 gross tons built in the United States and officially numbered during the month of September. The largest steel steam vessel included in these figures is the *Wilkesbarre* of 1,197 gross tons, built at Wilmington, Del.



BREAKWATER AT THE STERN OF THE CONNECTICUT TO BRING HER TO REST AFTER LAUNCHING.

VIEW IN THE BROOKLYN NAVY YARD, SHOWING THE CONNECTICUT IN THE DISTANCE.

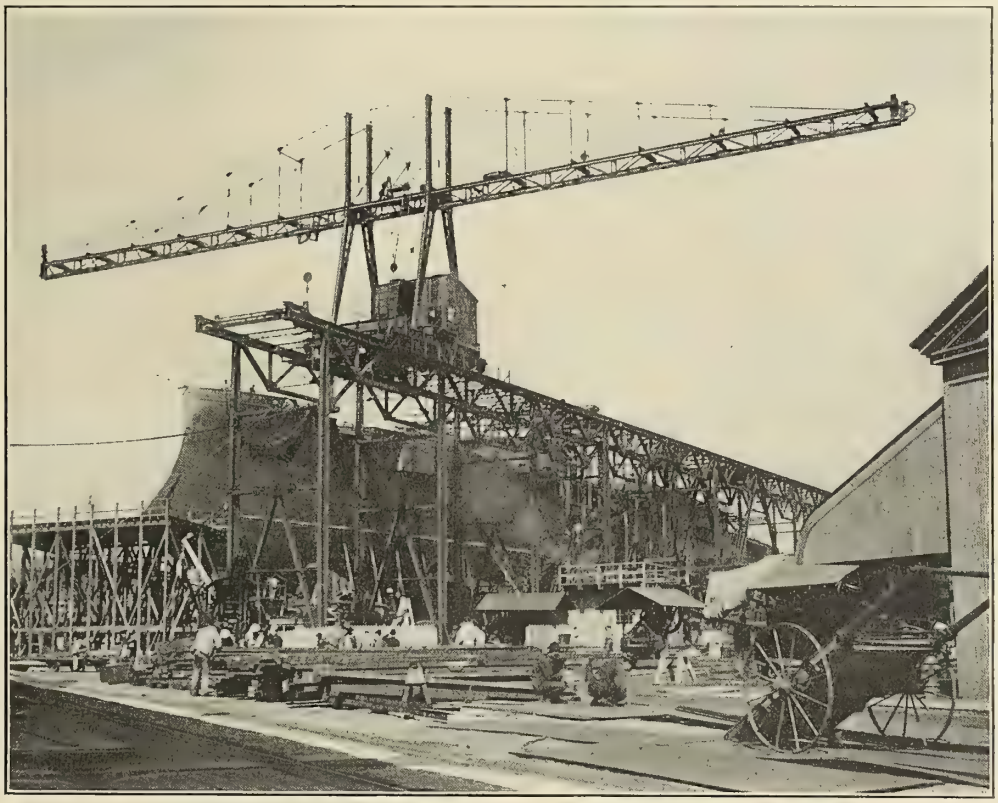
[Photographs by F. T. Hastings.]

TRIPLE SCREW PROPULSION.

BY REAR-ADMIRAL GEORGE W. MELVILLE, U. S. N., RETIRED.

The lessons of the war in the far east are more than interesting to the engineering profession, particularly so to that which relates to ship construction and marine engineering.

The order of our President is explicit that no officer of the army or navy of the United States shall enter into any discussion of the relative merits of either nation or course of action of either their fleets or armies. It is not only just that the President should issue such an order but that the order should be implicitly obeyed. But this does not bar us from learning lessons for ourselves that may be applied to the benefit of our navy in our new constructions. The first lesson we have learned is the necessity for a high powered fleet of fast ships, either battleships or armored cruisers, with great coal endurance, and perfect protection to the propelling power and steering gear of this class of ships.



BATTLESHIP CONNECTICUT AND NEW GANTRY CRANE, AT BROOKLYN NAVY YARD.

The lesson of the loss of the *Rurick*, the Russian armor-clad ship, the consequent delay and scattering of the Russian fleet at that time, the forced return of some of the ships of that fleet to Port Arthur and subsequent abortive attempt to join Russia's Vladivostock and Port Arthur fleets into one strong fighting unit, may be traced to the fact that the *Rurick's* steering gear or rudder and part of her propelling power were disabled at the same time.

As the report comes to us, it is said that a shell from one of the Japanese ships exploded under the stern of the *Rurick*, disabling her rudder or steering gear, and at the same time disabling one of her twin screws. Now, had this ship been a three-screw ship, as nearly all of Russia's modern ships are now fitted, as well as those of Germany and France, it can readily be seen that had her center screw and one of her wing screws remained intact, the ship could have proceeded with at least two-thirds power, and in an emergency even greater power could have been crowded through the two remaining engines and screws, so that not only the *Rurick* might have escaped but possibly the whole fleet. As it was, because of the delay of more than one hour, when the Russian fleet was trying to blanket and protect the damaged ship, the time thus lost if skillfully used, even in a running fight, might have saved the fleet to Russia. Whether this reasoning would apply in all cases and under all conditions is a question that it is impossible to decide offhand, for so many contingencies arise in battle that no fixed rule can be made to fit them all.

Accompanying this prelude to my subject, I take pleasure in stating the following reasons why the three-screw system should be applied to naval vessels of more than 3,000 tons, bearing in mind that it is not a new or novel system, but that it is in almost universal use in the navies of Russia, Germany, and France; Great Britain and the United States alone neglecting this great military advantage in time of war and the greatest source of economy in coal in time of peace or on blockade.

Not only for men-of-war alone, but for the high powered transatlantic liners, the three-screw system would prove most advantageous in case of accident to either engine or rudder, and as the increase of engineer

force in engine or fire rooms amounts to but 6 per cent. of the number of men, it is a small amount to pay for the increased security in mail-passenger service. In the United States protected cruisers *Columbia* and *Minneapolis* the additional force employed for each ship in the engine room, for oilers, was but nine men, or three on each watch for three watches when the ship was under way. Now that we are having numerous three-screwed turbine ships projected and being built, and many more projected with four shafts and propellers, three-screwed ships will cease to be a novelty and the traveling public on our high powered transatlantic liners will demand the three-screw system as they now do the twin-screw, and avoid a single-screw ship. After years of service the machinery of the *Columbia* and *Minneapolis* is reported in as good condition as when built, and the fleet engineer of the training squadron reports to the navy department that the ships are able to make the speed they did on their trial trips, which speaks well for their design, builders, and the care and attention they have had from the engineer force since they were first commissioned. In fact, the adoption of the three-screw system for ship propulsion will act as rudder and propeller if rudder or steering gear and any one of the three screws or engines is disabled.

The following are a few of the reasons in favor of the three-screw system. I have also stated some of the disadvantages that might arise from the system:

The triple screw is no novelty in naval construction. It has been used in Russia, France, and Germany. Russia possesses eleven naval ships fitted with triple-screw engines, and these ships are of late design. France has ten battleships and nineteen cruisers of this type, and the latest armored cruiser launched, *Dupetit-Thouars,* is fitted with triple screws. In the case of Germany the decision has been practically reached, after competitive trial of the twin and triple-screw systems, to adopt the triple-screw design exclusively in all future war ships of the home fleet. She has already 19 such vessels.

England alone, of the strong naval powers, continues to design twin screws for her most powerful vessels. In doing this she is only pursuing that same conservative policy which makes her refuse to drive her turrets electrically, and which impels her to shun superimposed gun turrets. If this conservatism upon the part of England, as respects the question of triple screws, is based upon sound engineering design, then what reason have we for maintaining that the British Admiralty is not equally justified in its decision to adhere to the hydraulic working of turrets, and in its determination to reject, for all classes of ships, the superimposed arrangement for heavy guns. Concerning the conservatism of the British Admiralty, *Marine Rundschau,* a leading German periodical, in its issue of March, 1901, says:

"It must be pointed out how inordinately conservative they (the English) are for holding on to old methods, and how they object to anything new in their navy. It was only after the French had built iron clads, and had successfully tried them, that the English decided to change their 'wooden walls' to iron ones; and they were many years behind other navies in adopting breech-loading rifles."

In matters pertaining to the navel personnel, it has been the practice of Great Britain to follow rather than to lead our service. In matters pertaining to the material, she has always assumed the conservative attitude, maintaining the position that as the greatest sea power she could rest well content with existing conditions, and that such construction as submarine and commerce destroyers are the expedients of weaker powers. Therefore, with respect to the best distribution of motive power, as well as with respect to the question of the arrangement and distribution of battery, the British Admiralty is regarded rather as observers than opponents of American precedents.

In adopting the triple-screw system there will not be introduced either any innovation or discredited design of motive power. The demand for this character of installation is made rather to prevent us falling behind our competitors in naval construction than in the desire to lead our rivals. The practical reasons for thus distributing the power in armored vessels may be embraced in three distinctive groups.

ECONOMIC ADVANTAGES.

Where judgment has been exercised in utilizing the power, marked economy has been secured by the use of triple screws. The economy of this installation is so well recognized by the Germans that the matter is no longer in dispute. It would be remarkable if there were not economic advantages. There must be a saving of coal where the distribution of power is of such nature that only the amount of machinery need be put in operation which can be run at economical speed.

The official trials of the *Columbia* and *Minneapolis,* when compared with those of the *New York* and *Olympia,* prove conclusively that there was a decided economy of propulsion. Probably no data were ever obtained with more care than in the official trials of the four ships named. There was an ample corps of trained observers. The system of observations was the result of experience after many official trials. The indicators had been most carefully calibrated by the same experts in all cases, and the apparent pressures were corrected for the errors of the instrument. There can be absolutely no doubt of the accuracy of the data.

Some of the special economical advantages are the following:

(1) In time of war, or emergency, the ordinary cruising can be maintained by the side engines while the center engine is run at just sufficient speed to clear its propeller. Where there is a necessity for an economical expenditure of coal, and an equal necessity for being in readiness to move quickly, the center engine can be run slowly while the side engines can just turn over. In either of the above cases the load on the engine that is just turning over is only that due to friction, and therefore the coal expenditure is exceedingly small. Such operation of triple-screw engines was actually done on the *Minneapolis* during the late war. When operating the engines in this manner it is only necessary to open all the throttles to secure a maximum speed. Such a condition or readiness at a slight cost of fuel can only be secured with triple screws.

(2) At full power the economy will be equal to or greater than with twin screws. At reduced speeds the economy will be much greater, thus increasing the steaming radius and keeping the vessel longer on blockade or other important duty.

(3) The economy is secured by more efficient propulsion. It is also attained by the more efficient use of steam in the engine, due to decreased condensation following the increased piston speed.

(4) The economy of the triple-screw system has been shown by actual experiments and experiences in our service. These results have been verified by the experience of the French and the Germans. Russia has not conducted comparative tests, but the general belief exists in that service that the triple-screw system is the most economical.

The economic superiority of the triple-screw design is now practically recognized by every nation that has possessed ships of the two types. Such judgment has been founded upon experience and experiments. A design of motive power which secured a reduction in the consumption of coal is of great military advantage. "Coal, or the want of it, is the life or death of a fleet." Its consumption must be reduced on the modern war ship, and the great trend of marine engineering research is in the direction of such economy. To continue building twin-screw engines in high-powered naval vessels is to be one engine behind in the race for naval supremacy.

STRUCTURAL ADVANTAGES.

In addition to the economic advantages resulting from the design, there are structural reasons why the system should be adopted. The following are a few of the resulting advantages:

(1) The engines can be made lighter, cheaper, and simpler.

(2) The subdivision of water-tight compartments is more efficiently secured.

(3) The nearer the screw to the center of the vessel the more efficient it is. The screw need not extend so far beyond the lines of the hull. The screw is less liable to disablement from ramming any floating obstructions.

(4) Shorter lengths of shafting can be used. The use of struts can be obviated under certain conditions.

(5) Smaller engine parts can be used. This is a marked military advantage, since it will not only reduce the cost of repairs, but permit the repairs to be made more rapidly as well as by a greater number of engine repair shops.

(6) The vibration is decreased. This advantage is of great importance, since it not only adds to the endurance and efficiency of the machinery, but contributes to the comfort of the crew, and passengers, if a passenger ship.

(7) Triple screws permit the installation of additional auxiliaries. The auxiliaries are the weak links in a modern battleship, and by the disablement of a single one a set of propelling engines can be thrown out of use. Where three sets of auxiliaries are installed, it would be but seldom that two sets of engines could not be kept in operation. In fact, two auxiliaries of any one description could be so forced that it might not be necessary to stop working any of the propelling engines if an auxiliary was disabled.

(8) More latitude is allowable in the design of machinery. Smaller and more efficient propellers can be designed, the piston speed increased, the foundations made lighter, the working parts smaller, and all permit greater ease of repairs.

Structural reasons first impelled the marine engine designer to suggest the triple-screw engines. The advantages were so apparent that the installation was secured. The resulting structural and engineering benefits were very great, and yet it is but fair to recount the disadvantages which the system entails.

The following are the principal structural disadvantages:

(a) Greater number of parts. In all high-powered naval vessels fitted with twin screws there are two sets of engines coupled on to each shaft. Six cylinders with their attendant working parts are required for each set of machinery, so that as a matter of fact there are more working parts with the twin-screw system of the same power.

(b) Greater number of valves and pipes; but these fittings are smaller, and therefore more easily overhauled and repaired.

(c) Greater number of auxiliaries. In the cross security of being able to use any auxiliary on any propelling engine this ought to be a marked advantage.

(d) Increased engine room force. The total increase in the fire and engine room force is about 6 per cent.

(e) Intricacy of piping. Additional piping of course is required, but no man competent to run high-powered machinery would regard the additional lengths of piping as producing complication, and in all cases the piping is smaller in proportion to the unit used.

(f) The engine space requires more room lengthwise. Space is utilized in the after part of the vessel, however, that could be only used as store rooms for spare gear.

The structural advantages so far exceed the disadvantages that from an engineering standpoint there can be no justification henceforth for the use of twin screws in large powered vessels. It must be understood that by the adoption of the triple-screw system we use three sets of engines instead of four. The *New York* and the *Brooklyn* have two sets of engines coupled to each of the twin-screw shafts for economy in fuel at low cruising speed. The experience of the *Brooklyn* at Santiago shows that where two sets of engines are coupled to the same shaft, the vessel would practically go out of action if the attempt were made to couple the shafts in times of emergency. These are sufficient structural reasons alone to justify the adoption of the system.

TACTICAL ADVANTAGES.

In addition to the economical and structural reasons for installing triple screws, there are tactical advantages to be secured. When the German Admiralty began giving consideration to this subject her experts did not look for other than economical and structural advantages. In fact, it was believed that investigation would show that tactical reasons would prevent the further use of triple screws in German war ships. With the thoroughness that characterizes German research, extended experiments were planned for the determination of this question. The *Friedrich III.*, fitted with triple screws, was pitted against the twin-screw ships *Brandenburg* and *Sachsen*. All manner of tactical evolutions were attempted. To the surprise of the German experts the *Friedrich III.*, fitted with triple screws, showed a marked tactical superiority over her rivals.

These experiments caused increased attention to be given to the tactical reasons for adopting the triple-screw

system. It was found that the ships fitted with such installations steered best, and that the art of steering was more easily acquired by the sailors, as the ships took no rank sheer, as is found to be the case with vessels carrying twin or single screws.

As confirmatory of the *Friedrich III.-Sachsen* experiments the following particulars are given: The first squadron of German battleships, comprising three vessels of the *Imperial* type, *Emperor William the Great, Emperor William the Second,* and *Emperor Barbarossa,* fitted with triple screws, made two long cruises during the past summer. It is reported of them that they could be more easily steered and manœuvred, a new proof of the advantages of the triple screw over the double propelling system of the *Brandenburg* type.

The remarkable fact is now presented of the German experts declaring that it is principally for tactical reasons, and not by reason of the structural and economical advantages, that Germany has settled upon the policy of using triple screws for all large-powered ships in home waters. The following are the principal tactical advantages:

(1) Increased assurance of working the entire machinery. This is of special importance in battle or in time of emergency, when maximum power is required for a short period. At Santiago the *Brooklyn* could not use her maximum power because only the after engines of each shaft could be used, the forward engines being uncoupled.

(2) Decreased liability of imperilling the motive and manœuvring power of the vessel. This advantage arises from being able to install the screws near the center of the vessel, thus decreasing the chances of the propellers being hit by a floating obstruction.

(3) The steering or manœuvring qualities of the ship are not so likely to be interfered with in triple as in double screws, since it is not likely that more than one engine will be disabled, as in the case of the Russian battleship *Rurick.*

(4) A tactical advantage, not hitherto shown, is better control when under stern board. An experiment with the *Columbia* when in a narrow channel went to show that she could readily be steered when going astern by carefully handling the engines and disregarding the helm, the helm being amidships. This we know cannot be done with either single or twin-screw vessels.

(5) A helm angle from 6 1-2 to 10 degrees is required to keep a twin screw on her course when only one screw is used. No such angle would be required when one of the three screws is disabled.

(6) Greater safety of machinery due to better distribution of power.

(7) In case the rudder is carried away or disabled the triple-screw ship can be more easily handled, since the wing screws can be used for guiding and the center one for propelling the vessel—again the *Rurick.*

(8) All the tactical advantages secured by twin-screw vessels are maintained; additional ones are attainable.

The *Brandenburg-Sachsen* experiment showed that evolutions could be performed with triple screws that could not be done with twin screws. The March number of the *Marine Rundshau* gives detailed description of buoy experiments which could only be performed by ships fitted with triple screws.

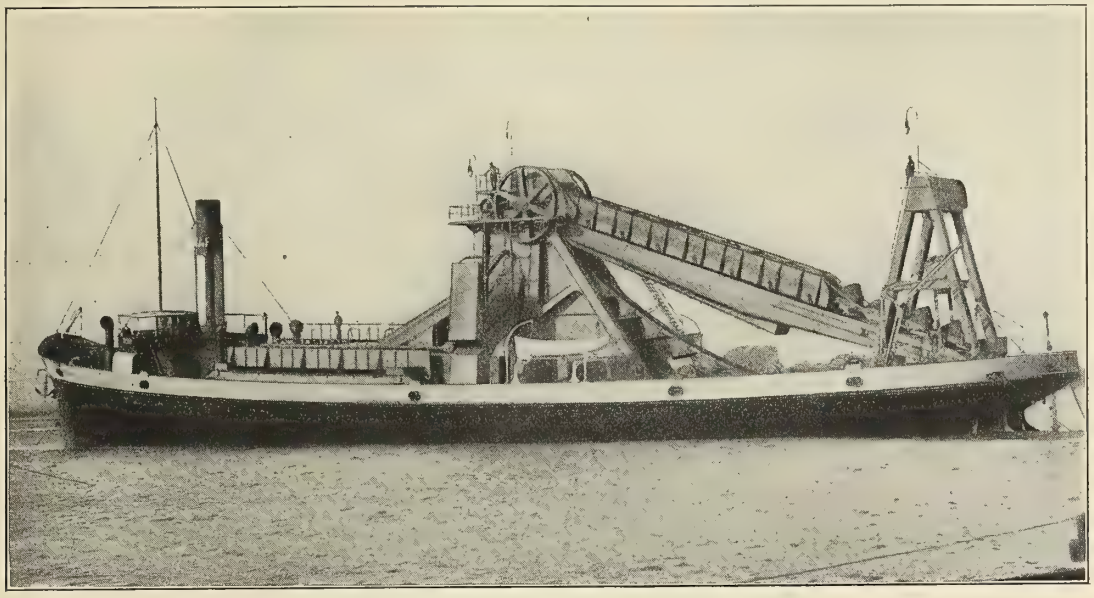
Since the triple-screw design permits smaller engines to be used, there is a tactical and military advantage in such construction. Smaller engines are cheaper, lighter, simpler, more easily managed, and more easily overhauled. This may be of great significance, now that we are finding such difficulty in securing trained men for the engine rooms of our war ships. In view, therefore, of the economical advantages, as shown upon official trials; of structural advantages, as recognized by marine engineers, designers, and builders, and of tactical advantages, as determined by careful experimental investigation and research, there should be no hesitancy in using the system.

The distribution of the motive power is no less important than the distribution and arrangement of the battery. It is just as logical to arrange the battery of the new war ships in the same manner as was done a decade ago as it is to continue the custom of installing a twin-screw arrangement of motive power that is not in accord with existing needs.

For the past five years I have continuously and consistently urged the installation of triple screws for high-powered ships. My only regret now is that I was not more insistent in urging the adoption of the system. Under several occasions I determined to present a minority report against twin-screw engine propulsion for high-powered ships. Such official protests were not made because the assurance was given that there were grave tactical objections to its introduction, and that data to support the contention would be furnished. With each succeeding year progressive evidence has been adduced that the system is not only in accordance with sound engineering practice, but it supplies a tactical need of the future battleship.

The triple-screw system for high-powered naval vessels is no longer either an innovation or an experiment—it is a military necessity. The continued installation of twin screws in such vessels is not only against progressive engine design, but fails to meet the military and tactical requirements of the future. If such practice continues our naval prestige will be lessened. To defer adopting triple screws is marked retrogression. The distribution of power by triple screws is simply keeping pace with the best naval construction of Europe. Any action of a contrary nature is simply discrediting the ships in process of design. It is, therefore, imperative that this system be adopted unless the facts herein set forth can be controverted.

Annapolis School the Model.—Captain William H. Bronson, superintendent of the Naval Academy at Annapolis, recently returned from a tour of investigation of the naval educational methods of Europe. He stated that it was gratifying to find that England, which had been ridiculing the American system of naval education for many years, and had finally condemned the establishing of an academy, was now establishing naval schools virtually modeled after the academy. One school had been opened at Osborn and another would be opened at Dartmouth next year. In Germany a naval school, which Prince Henry stated was to be a small Annapolis, will be opened next year.



SELF-PROPELLED DREDGE FOR BUCKET AND SUCTION DREDGING.

COMBINED BUCKET AND SUCTION DREDGE CONSTRUCTED FOR THE GOVERNMENT OF URUGUAY.

A longitudinal section of the interesting self-propelled bucket and suction dredge to be described in this article, is shown by Fig. 1, while Fig. 8 represents it as ready for sea.

This boat has been lately built by Messrs. A. F. Smulders, of Rotterdam, for the harbor works now in progress at Montevideo, on behalf of the government of Uruguay. The special feature is the arrangement by which dredging may be carried on at will through the same well, either with a chain of buckets or by means of a suction pipe. When using buckets, the dredge can work to a depth of from 13.1 feet to 32.8 feet below the surface of the water, with the ladder in its ordinary position, while by altering the upper bearing of this to a special support, the depth reached can be extended to 42.7 feet below the water line. The transmission is so arranged that every minute 16 buckets will pass the top pinion. The minimum excavation demanded by the contract is 654 cubic yards per hour, when dredging at a depth of 26.3 feet.

The boat is so arranged that it can deliver the spoil either into hopper barges placed alongside, or into its own well, which has a capacity of 1,046 cubic yards. This is best seen in Figs. 3 and 7. The freeboard of the barges when unladen is 9.8 feet, and they are to be moored 6.6 feet away from the dredge when receiving their load. When carrying its own spoil the dredge was required to draw not more than 14 feet, and to be capable of steaming out to sea for unloading. When arranged for suction dredging, the machine works at depths of from 13.1 feet to 32.8 feet, and when dredging at depths of 26.3 feet it fills its well of above-named capacity in 40 minutes. When laden the speed in proceeding to sea was required to be not less than 7 knots, and the engines were also required not to consume more than 2.2 pounds of coal per I. H. P. per hour. The dredge has been built under the survey of the Bureau Veritas, and was awarded the highest classification. When finished, it proceeded to Montevideo under its own steam.

The results obtained on the official trials, made on behalf of the Uruguay government on the Meuse (Dutch river), during a period of fifteen days, are as follows:

	Conditions of contract	Actual results
Dredging by bucket, cu. yds. per hour.....	654	850
Suction dredging, " "	1,570	2,350
Speed, knots	7	8.2
Fuel consumption, lbs. per I. H. P. per hour...	2.20	2.09

The hull is built entirely of Siemens-Martin steel, and is 241 feet long by 41 feet wide, by 17 feet 3 inches depth of hold. The hopper has a capacity of 1,250 tons, and is 50 feet long by 33.8 feet wide at the top, and 23 feet wide below. Fully laden, and carrying 50 tons of fuel in the bunkers and 5 tons of water in the boilers, the draft is 14 feet. The hull is provided with the necessary accommodations for the engineer, the first and second dredging master, the chief mechanical engineer and his assistants, while the crew's quarters are provided forward as shown on the plans.

There are two engines of the horizontal compound type, placed nearly amidships—Figs. 1 and 3—which can drive at will either the centrifugal pumps of the suction installation, the dredging chain, or the two screw propellers. The two engines together develop 1,000 I. H. P. They are supplied with steam by two ordinary return-tube boilers, placed forward and built of steel for a working pressure of 113.8 pounds per square inch. The two boilers together have a heating surface of 3,444 square feet. Fig. 6 gives a section through the stokehold. The steam auxiliaries comprise a dynamo engine, centrifugal circulating pump, two Worthington boiler feed pumps, and eight double-cylinder steam winches used in manœuvring the craft.

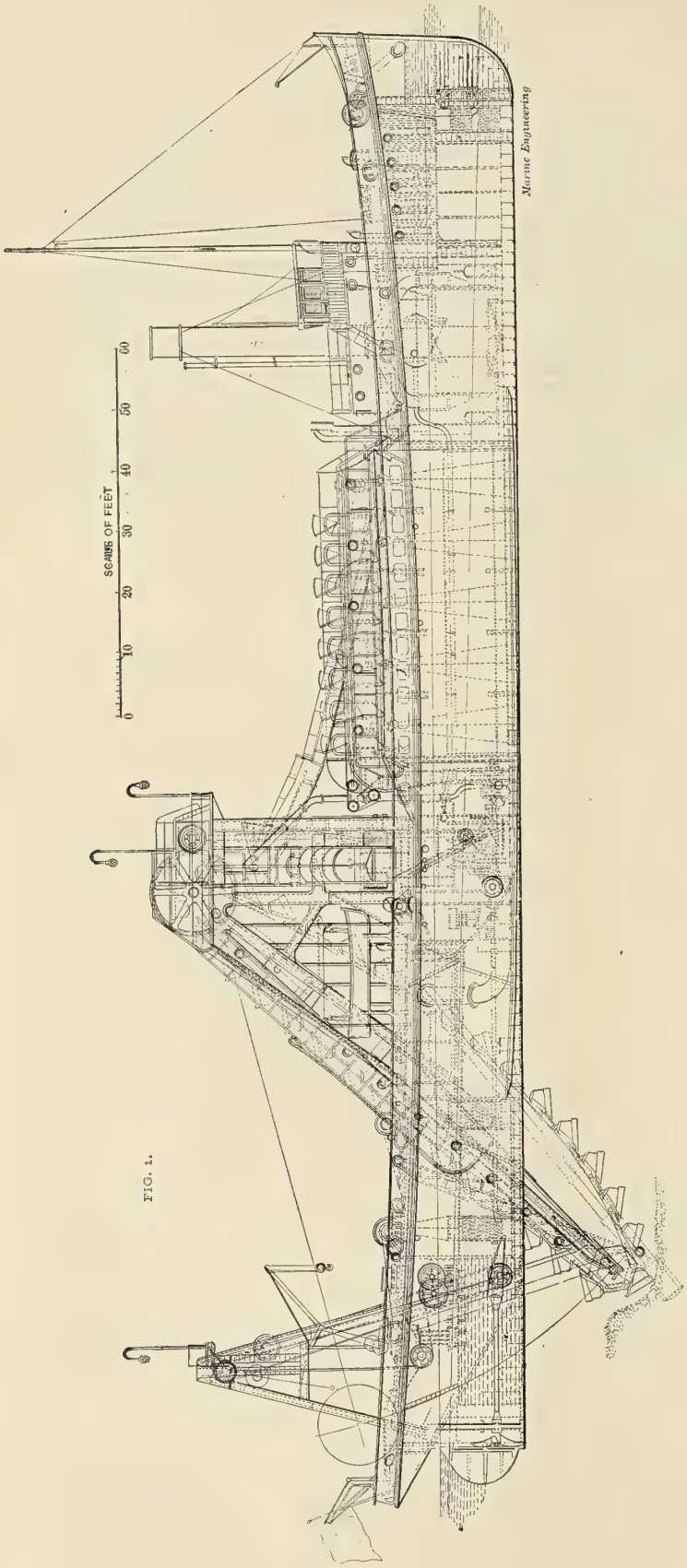


FIG. 1.

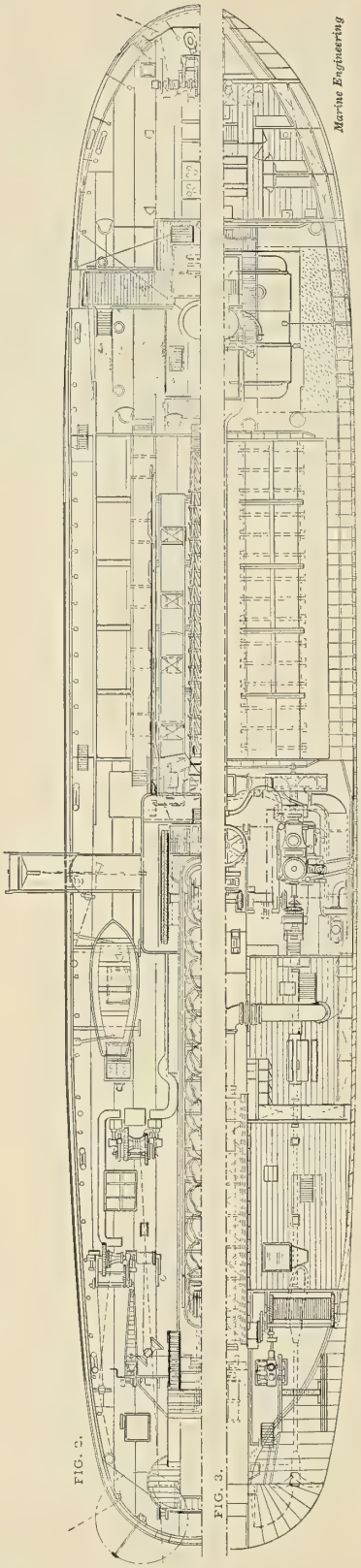


FIG. 2.

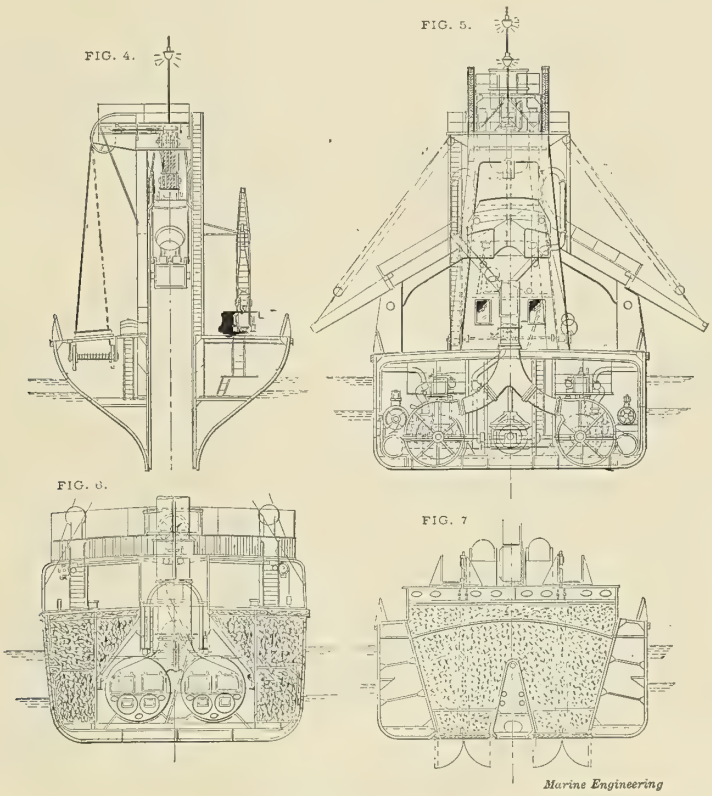
FIG. 3.

INBOARD PROFILE AND DECK PLANS OF URUGUAY DREDGE.

The buckets, which have a capacity of about 28 cubic feet, are of eliptical form, the body being of steel plate, sides, back, and lips of cast steel. They are 32 in number. The links are alternately steel castings of double T-section and steel plates; they are provided with removable bushings of Hadfield's manganese special steel, which can be readily replaced after wear. The bolts are also of the same steel, and have square heads to prevent turning save in the long bushes.

The transmission gear is so fitted to the main engines that either engine may be used for driving the chain, or for running the centrifugal suction pump. It is also possible to use one engine for driving both screws, while the other runs one of the centrifugal pumps. In the latter case, one of the screws is driven by means of gearing. The centrifugals are driven direct from the engine, but the dredging chain is driven through steel spur and bevel-gearing—see Figs. 2 and 5—by means of friction clutches, which in case of an excessive load slip on the chain and thus prevent breakage. The centrifugal pumps, which are designed for a minimum speed of 150 revolutions per minute, are driven direct through claw couplings on the crank shafting. The pumps are built up of steel plates and angles, with renewable wearing plates of steel fitted inside the casings. The impellors have four arms, also fitted with renewable wearing plates, and all parts may be readily inspected.

The framing carrying the upper pinion for the dredging chain is removable above deck level. The forward legs are riveted to the well sides, and are supported by heavy floors on the bottom at each side of the well. The rear legs rest on the deck, which is stiffened below by a strong beam running across the hull. The total distance from the bottom of the columns to the top of the pinion framing is 53.3 feet. The ladder frame, constructed in an extra-strong manner of plates and angles, is a built-up beam 88.6 feet long, which permits dredging to be done in depths up to 32.8 feet of water, as previously stated, without shifting the upper support of the ladder. The upper pinion is of square section, cast in a single piece out of white iron. The lower pinion is hexagonal and is a steel casting. The suction pipe may be stowed above the water level when the dredge is fully laden. The discharge pipe from the pumps, which is provided with sluice openings corresponding to each section of the hopper, is of rectangular section, and runs along almost the whole length of the hopper.



SECTIONS OF A COMBINED BUCKET AND SUCTION DREDGE.

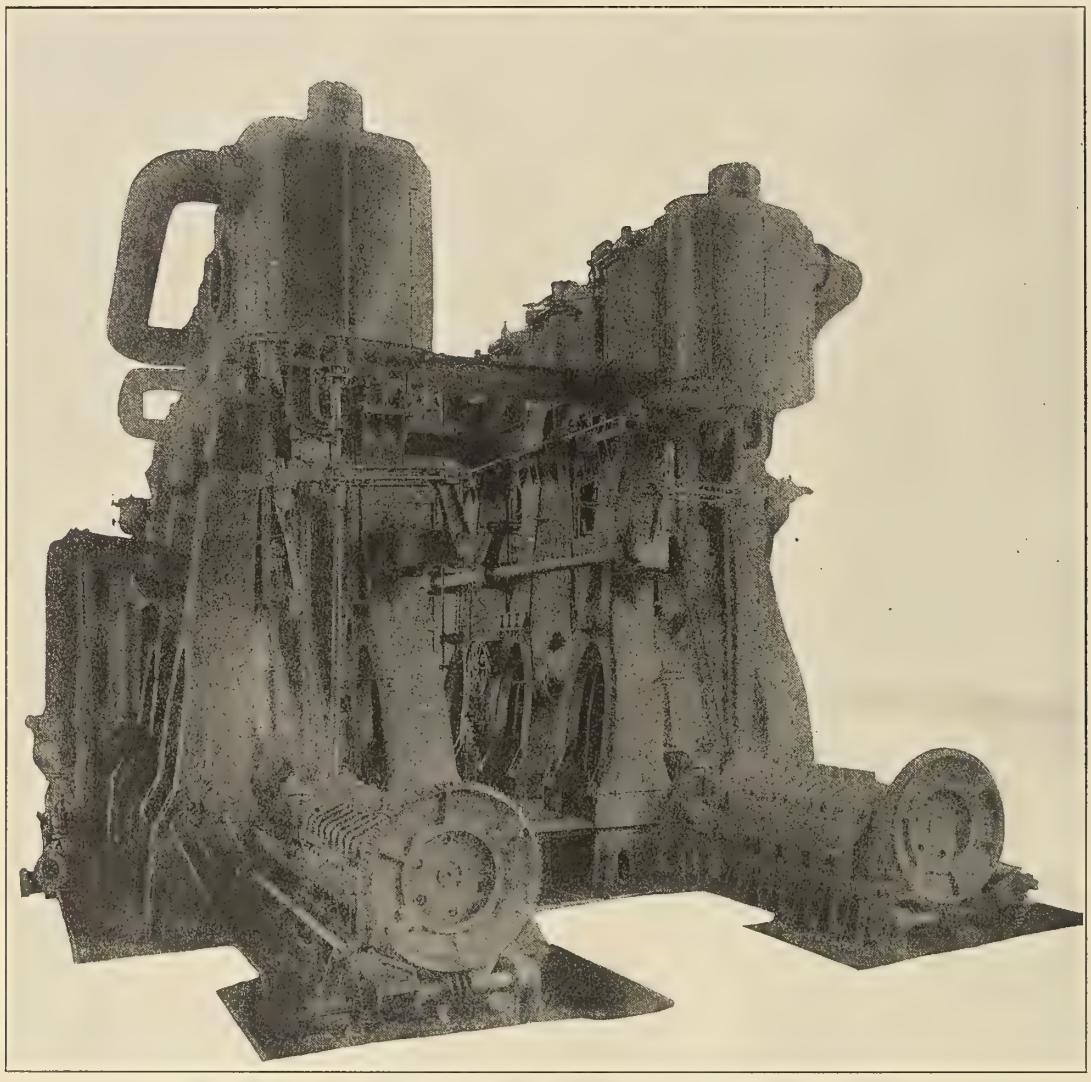
The deck of the boat is lighted electrically by means of three 1,000 candle-power arc lamps, and in addition there are incandescent lamps in cabins, engine rooms and stokehold. The navigating bridge is placed directly forward of the funnel, and is fitted with steam-steering gear, engine telegraphs, etc. A single formast is fitted as shown. Two life boats with mast, oars, and rudder are swung from davits, and rest on supports above the deck, so as to be out of the way.

Japanese Twin Screw Steamship Aki-Maru.

As evidence of the rapid strides made in Japanese shipbuilding, the new steamer *Aki-Maru,* here illustrated, bears conclusive proof. This vessel was built for Messrs. Nippon Yusen Kaisha by the Mitsu Bishi Dockyard & Engine Works, Nagasaki. The ship is a twin-screw, 15-knot, freight and passenger vessel, for the transpacific trade. She is built with poop and forecastle, and midship deckhouse in which all the first cabin accommodations are placed. The third cabin is placed under the poop deck and in addition the aft end of main deck is arranged to be fitted with berths for steerage. The sailors' quarters are in the forecastle, while the firemen are on the main deck forward.

A double bottom extends the entire length of the ship betwen collision bulkheads. There are three large cargo hatches leading to the forward holds, hatches Nos. 1 and 2 being worked from the foremast and by two steam winches each, and hatch No. 3 from two steel derrick posts, also serving as ventilators. A large cross bunker is at the forward end of fire room, and there are small pocket bunkers on each side of forward end of engine room. A fresh-water tank extends from top of thrust-shaft recess to main deck; above this is refrigerating space. Part of the No. 4 hold is built as a deep tank. The capacity of this tank is 490 tons; the capacity of the water bottom 1,177 tons, that of the forward and aft peak tanks, 130 tons, or a total of 1,797 tons of ballast, which will increase the vessel's draft when light 2 feet 5 inches.

The vessel is fitted with twin-screw triple expansion engines, which are shown in the accompanying engraving, and the cylinders are 20, 33 1-2 and 56 inches diameter by 48 inches stroke. Steam at 200 pounds pressure is supplied by two single-end and two double-end boilers. For other data see card on page 526.

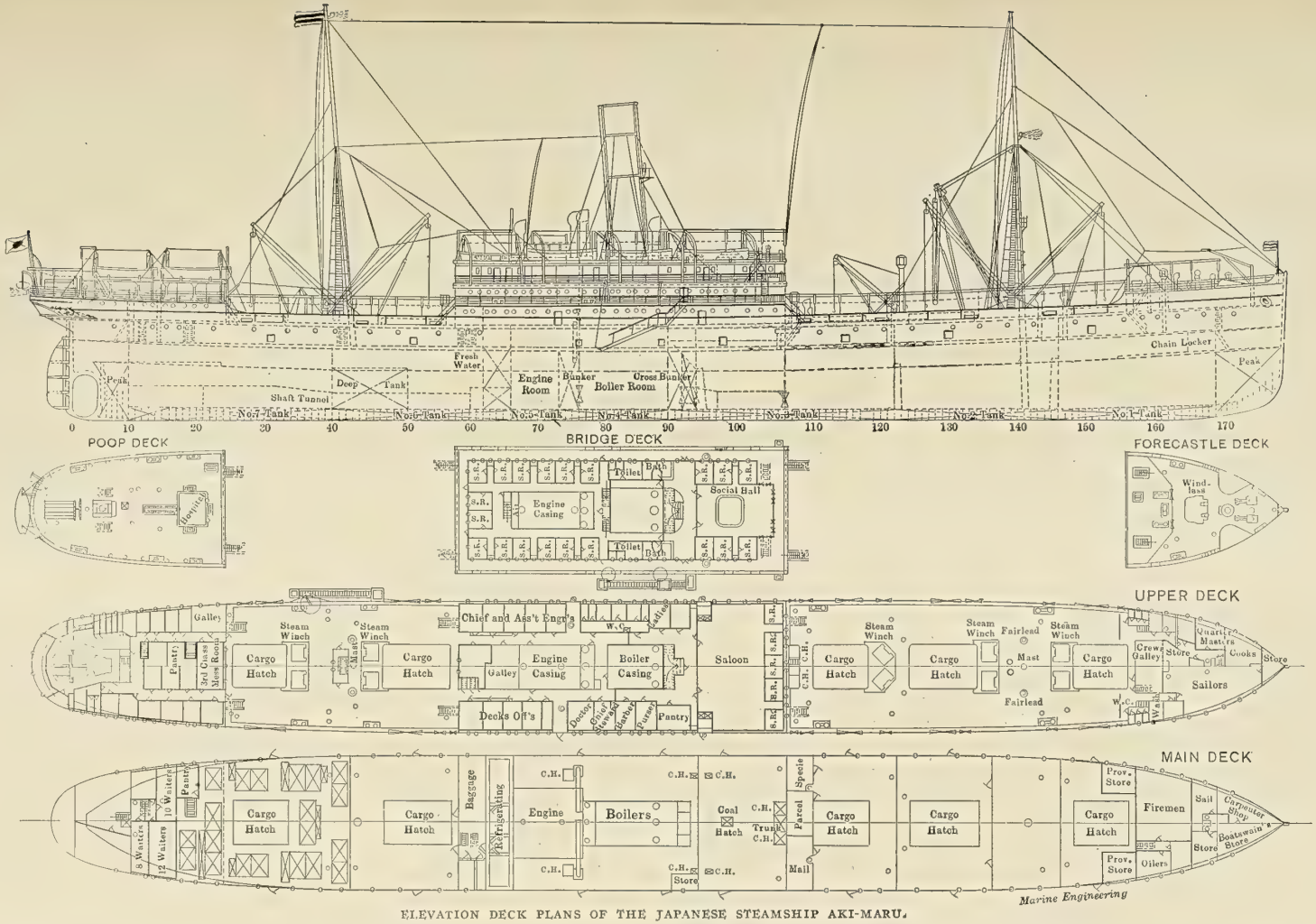


TWIN SCREW, TRIPLE EXPANSION ENGINES FOR THE JAPANESE STEAMSHIP AKI-MARU.

The Sale of the Union Iron Works.

The sale of the Union Iron Works, September 26, 1904, to the Reorganization Committee of the U. S. Shipbuilding Company for $1,700,000, marks an epoch in the shipbuilding and engineering business of the Pacific coast.

This plant was founded in 1849 by Peter Donohue; later it became H. J. Booth & Company, and still later,



ELEVATION DECK PLANS OF THE JAPANESE STEAMSHIP AKI-MARU.

Prescott, Scott & Company. During these days, Mr. Irving M. Scott became a managing owner in the firm, and from this time until his death, in 1903, the history of the Union Iron Works was one of progress and growth. From a small blacksmith ship and engine factory in the center of the city, Mr. Scott, in 1883, moved the plant to the Potrero water front in order to take up shipbuilding. Shortly before Mr. Scott's death, and before the shipyard was taken over by the United States Shipbuilding Company, there was at practically the same time the following marine work in progress at the works:

For the Hawaiian & American line, three freighters building, *Californian, Arizonan, Alaskan.* For the U. S. navy, cruisers *California, South Dakota* and *Milwaukee;* battleship *Ohio;* monitor *Wyoming;* cruiser *Tacoma;* torpedo boats *Perry, Preble, Paul Jones;* submarines *Pike* and *Grampus;* two ships having oil burning system installed; one oil tank steamer built; one pontoon dock fate for Russia and one for Hunter's Point, and much milling work. At present they are building three cruisers, besides numerous repair jobs.

NAVAL ARCHITECTURE.*

BY SIR WILLIAM H. WHITE,[1] K. C. B., F. R. S.

At the request of the committee this paper has been prepared in order to place before the International Engineering Congress a summarized statement of the development of naval architecture in Great Britain during the last ten years. Within the limits of space assigned, it is only possible to indicate the principal advances made in methods of ship construction and propulsion; some points of interest and practical importance have necessarily been omitted.

BRITISH WAR SHIP BUILDING IN 1894.

It will be convenient to note at the outset the condition prevailing in British shipbuilding in 1894. In many respects that date is notable. In regard to war ships, it marked the practical completion of the great programme of construction which had been embodied in the Naval Defence Act, 1889. Under that act provision had been made for adding 70 ships of various classes to the navy, including 10 battleships, 9 first-class cruisers, 29 second-class cruisers, 4 third-class cruisers, and 18 torpedo gunboats. The original estimated cost of these vessels and their armaments was 21 1-2 millions sterling. In certain classes modifications were made and dimensions increased as the programme was executed, in order to obtain greater fighting and sea-keeping capabilities. About a million sterling was thus added to the cost; the fact being recognized when the changes were authorized. The actual outlay on the 70 ships was about 22 3-4 millions sterling; about four-fifths of that sum being expended on hulls, armor, machinery, and gun mountings, and one-fifth on guns, torpedoes, and ammunition. Taking into account the fact that the vessels were of novel types, of unprecedented speed, and armed with the first quick-firing guns of large caliber, this was a remarkably close approximation between estimate and expenditure. Thanks to the splendid resources of the United Kingdom in ship yards, engine factories, and steel works, the programme was practically completed within the five years contemplated, although that period was marked by abnormal activity in mercantile shipbuilding, about 5 1-2 millions of tons of new ships having been launched in the years 1889-93.

Having been responsible for the designs of these seventy ships, as well as for the estimates of total cost and distribution of expenditure over the quinquennial period, and having also been charged with the direction of the work of construction and the supervision of the manufacture of armor and other materials, it is naturally a matter of satisfaction to record the successful accomplishment of this undertaking, which was pronounced to be impracticable by many authorities. But it is pleasant to add that this result was chiefly due to the magnificent shipbuilding, engineering, and metallurgical establishments of Great Britain, established and maintained by private enterprise. Even for the 38 ships built in government dock yards, private firms provided all the materials, the machinery, the armor, and a large proportion of the armament, the contribution of the dock yards being confined to the labor—representing an aggregate cost of about £3,750,000—expended in the combination of materials and mechanisms furnished by private industry.

This was the first great programme of construction for the Royal Navy carried out on definite and systematic lines. It stands alone in having been published in its entirety before the work began. Since 1894 there have been other programmes, some of them of greater magnitude. These programmes have been dealt with, officially, as elaborately as the Naval Defence Programme, and have been carried through with equal success. In these cases, however, there has not been previous publication of the full programme, but only of such parts as were included in current naval estimates. Of the two systems, it would appear that the latter is undoubtedly to be preferred. It is obvious that when a programme is disclosed beforehand in its entirety, as was done with the Naval Defence Act, competitors are fully informed and can make arrangements (working on a plan mutually devised or under a common agreement) by which the effort decided upon by Great Britain can be matched and neutralized. On the other hand, as Great Britain possesses an enormous superiority in shipbuilding resources, and can produce vessels more rapidly and at less cost, it is her wisest policy to publish only the programme of construction for each year, based on the numbers and types of vessels which may have been laid down abroad, taking care that the completion of British ships shall always be secured before that of corresponding foreign types.

Battleships of 1894.—In 1894 the largest battleships in the Royal Navy were vessels of the *Royal Sovereign* class, 380 feet in length, 75 feet in breadth, of 14,150 tons displacement and 17 1-2 to 18 knots maximum speed, carrying four 13 1-2-inch guns and ten 6-inch quick-firing guns, besides smaller weapons. The largest cruisers afloat were the *Blake* and *Blenheim,* designed in 1888. They are 375 feet in length, 65 feet in breadth, about 9,100 tons displacement, with a maximum speed of 22 knots.

Cruisers of 1894.—The first-class cruisers of the *Edgar* class, built under the Naval Defence Act, were somewhat smaller than the *Blake* and *Blenheim,* and their maximum speed was about 21 knots. The second-class cruisers were of two types: one of 4,300 tons, the other of about 3,500 tons. All had a speed of about 20 knots. All the cruisers had protective decks and no side armor. Battleships and cruisers had cylindrical tank boilers, with closed stoke holds and forced draft.

Torpedo Gun Boats of 1894.—The torpedo gun boats of the *Sharpshooter* class were designed as the smallest type capable of independent sea service and as adjuncts to a fleet. They were 230 feet long, 27 feet broad, of 735 tons displacement, and were fitted with locomotive boilers intended to develop 4,500 horse power, corresponding to a maximum speed of 20 knots. Locomotive boilers, when fitted in "groups," failed to realize the intended power, although it should have been easily obtained on the basis of results secured with one or two boilers in many torpedo boats previously built. The sister ship *Speedy,* was constructed (1892-93) with water tube boilers of the Thornycroft type, and the stipulated engine power was easily realized, the original estimate for speed being verified on trial. This was the first vessel in the Royal Navy, above the size of torpedo

*Paper read before the International Engineering Congress, St. Louis, Mo., October 8, 1904.

[1]Late Director of Naval Construction, England.

boats, fitted with water tube boilers. In recent years these vessels have been re-engined and fitted with water tube boilers, attaining speeds of 21 1-2 knots.

Armor.—The armor used on the ships of the Naval Defence Act was for the most part steel faced iron; but in some of the vessels all-steel armor was introduced for the first time in the Royal Navy as the result of experiments which had been initiated in 1888. Nickel steel armor of moderate thickness was used for the protection of superstructures.

Majestic Class.—In 1894, a further scheme of construction was begun, known as the "Spencer programme." This led to the design of battleships of the *Majestic* class. The characteristic features of these vessels are too well known to need detailed description. They are 10 feet longer than the *Royal Sovereign* class and of 14,900 tons displacement. The disposition of the armor on the hull differed essentially from that of the *Royal Sovereign* class, the armor on the citadel being of uniform thickness and no water line belt being fitted. The arrangements of the protective decks were modified. The use of Harveyed armor gave a large increase in defence for a given weight and thickness of armor, as compared with the all-steel armor, or the steel faced iron armor, which had been previously used. The first experiments with Harveyed armor were made in England at the end of 1892, the system having been introduced to the Admiralty by a representative of the Harvey Company of the United States. English armor plate makers had previously patented processes of a similar character; but action taken in the United States by Mr. Harvey and those who supported him led to the perfection and practical adoption of this system. For the principal armament of the *Majestic* class, guns of 12-inch caliber were adopted instead of the 13 1-2-inch guns of the *Royal Sovereign* class. Had a satisfactory and well proved type of 12-inch gun been available in 1889, it would have been adopted. The 13 1-2-inch gun was used in the *Royal Sovereign* class because it was immediately available, and because past experience had shown that in order to secure rapid and economical construction it was absolutely necessary to determine the nature of the armament before the work of building war ships was begun. This principle still holds good; neglect of it inevitably leads to delays, increased expenditure and other unsatisfactory results. The secondary armament of 6-inch, quick-firing guns in the *Majestic* class was much better protected than that of the *Royal Sovereign;* the casemate protection being much extended, while greater facilities were provided for the service of ammunition along well-protected passages, lying low in the ship. Both these features had been recognized previously to be important, but equal effect had not been given to them in earlier designs. It is now universally admitted that the principles illustrated in the *Majestic* class are of paramount importance to fighting efficiency. With quick-firing guns and high explosives it is essential to provide adequate protection for the secondary armament and for the men employed thereat, as well as for the transport of the ammunition. Large supplies are required with quick-firing guns, the magazines must be kept cool to prevent deterioration of the charges, and provision must be made for rapid supply of ammunition to the guns, if the full efficiency is to be realized. Provided these conditions are fulfilled, it may well prove advantageous to adopt less numerous but better protected armaments, and mere multiplication of guns may involve reduced fighting power. For defence against torpedo attacks a considerable number of quick-firing guns were mounted in all Naval Defence ships, and torpedo nets were fitted to the battleships and largest cruisers. By common consent the *Majestic* class is regarded as having greatly influenced all subsequent battleship construction.

Powerful and Terrible.—The year 1894 also witnessed the design of the protected cruisers *Powerful* and *Terrible,* which were built for the purpose of meeting the Russian cruisers *Russia* and *Rurik.* The water line region of the Russian ships was protected, for a portion of the length, by a narrow belt of vertical armor, and they carried a large number of guns practically destitute of armor protection. After full consideration of their offensive and defensive qualities, it was decided, in the *Powerful* and *Terrible,* to adopt a strong protective deck as the main defense of the vitals, rather than to fit a narrow belt of vertical armor over a portion of the length of the water line. It was also decided to accept a smaller number of guns, but to provide efficient armor protection for the 6-inch and 9.2-inch guns. The service of the ammunition was arranged, not merely so as to secure adequate and rapid supply, but to give thorough protection during its transport from the magazine to the guns. A great superiority in speed and coal supply was also secured in the *Powerful* and *Terrible,* their dimensions being correspondingly increased.

Perhaps the most notable feature in the vessels was the adoption of water tube boilers of the Belleville type. This step has been strongly condemned on the ground that it was unwise in war ships of such unprecedented power and speed to adopt a type of steam generator which was regarded as experimental. It is not necessary to justify what was done in these vessels; but it may be stated that the strong and capable committee, appointed four years ago by the Admiralty to investigate the general subject of water tube boilers fitted in war ships, has approved the action which was taken by the Admiralty in 1894. Moreover, it is undoubted that, unless water tube boilers had been adopted, the design of the *Powerful* and *Terrible* would have been impossible apart from greatly increased dimensions and cost. Even when favored by the adoption of this light type of boiler, their dimensions far exceeded those of any other cruisers, although they were still much inferior in size to the largest and swiftest passenger steamers of that period. The length of the *Powerful* was 500 feet; beam, 71 feet; displacement, 14,200 tons; speed, from 22 to 22 1-2 knots, and horse power, 22,000. As the vessels were intended for distant and long continued sea service, it was decided to sheathe their bottoms with wood and copper, in order to prevent fouling and consequent loss of speed. These features involved more than 600 tons additional weight and increased the cost by about £45,000. If the vessels had been built with bare steel bottoms, like more recent cruisers, the displacement would have been about 13,500 tons. This fact has been very generally overlooked by critics of the design, who ignore the importance attached by the Admiralty to sea-keeping capability and power of maintaining speed for long periods on

stations where docks are not available. The adoption of water tube boilers in the *Powerful* and *Terrible* was naturally followed in other classes of ships. In this policy French naval authorities had led the way, and French experience was necessarily drawn upon when the new departure was under consideration. For a time battleships were still fitted with cylindrical tank boilers; but since 1896 there has been universal use of water tube boilers for all classes of ships in the Royal Navy. Difficulties there have been, no doubt, as must have been anticipated with such a great experiment in a new direction. As experience has been gained, and the relative merits of competing types of boilers have been practically determined, these difficulties have been overcome. The great advantages obtainable with water tube boilers have been confirmed, and their comparatively inferior economy in coal consumption has been remedied. The Admiralty Boiler Committee, in preliminary reports (1903) advised the use of a combination of tank and water tube boilers in order to secure greater economy of coal when cruising at low speeds. In the writer's address in November, 1903, at the Institution of Civil Engineers, he stated that this system was carefully considered in designing the *Powerful* class, and was set aside in favor of a complete installation of water tube boilers. Further, he ventured the opinion that the boiler committee would eventually reach the same conclusion. It is interesting to note that this anticipation has already been realized, and that for the latest designs the committee has recommended the exclusive adoption of water tube boilers for H. M. ships. As yet the determination of the best types for use is still incomplete. Experience alone can settle that question, and it is probable that no single type will be found suitable for all conditions and classes of ships. The tank boiler has been brought to its present state of efficiency by a long period of use and successive steps in improvement. Critics of water tube boilers fail to make allowance for their recent introduction and the limited experience hitherto gained in actual sea service. But the advances already made are a guarantee of ultimate success and widely extended use for water tube boilers, if the steam engine continues to be used for ship propulsion.

TORPEDO BOAT DESTROYERS.

In 1894 the earliest examples of torpedo boat destroyers had just been completed and subjected to experiment. The results were so satisfactory that the Admiralty decided immediately to raise the total number of destroyers to 42, and in order to insure rapid advancement of construction, the orders were widely distributed, and a flotilla was thus made ready for service in an unprecedentedly short time. The design of these vessels was based upon that of torpedo boats, but they were much larger; the length was about 200 feet and displacement about 250 tons, with speeds of 27 knots. In consequence of their larger dimensions and armament of quick-firing guns, these destroyers could run down in a sea way and destroy any torpedo boats of that period. They also carried a considerable torpedo armament, which at first was treated as alternative to the gun armament, but eventually carried in association therewith. Very considerable developments of the type have been made since 1894, and the lead of the Admiralty has been followed in all navies. Probably the most interesting circumstance in connection with the construction of these destroyers was the fact that when the necessity arose for rapid additions to this class it was found possible to distribute the orders among fourteen firms, who undertook and successfully carried out the contracts; although up to that date Messrs. Thornycroft and Messrs. Yarrow had built nearly all the vessels of the torpedo flotilla constructed in England, while Messrs. White, of Cowes, and Messrs. Laird of Birkenhead, had undertaken some work of that class. There had been no more remarkable evidence of the unrivalled shipbuilding resources of Great Britain. Within a short period the country was put into a position to deal with the formidable menace of torpedo attack on its fleet, when in channel ports, which previously threatened its safety.

SUBMARINES.

The construction of submarines in England had been intermittent and very limited in extent up to 1894. Four or five vessels of the class had been built, the largest and best boats by Mr. Nordenfelt, from designs largely due to Mr. Garrett, who also undertook the superintendence of the trials. Greece and Turkey acquired the vessels as built, but the Admiralty did not make any purchases. Another submarine vessel built on the Thames attracted attention a few years earlier (1887). She was named the *Nautilus,* and the writer had some personal experience of her qualities, not altogether satisfactory. No other vessels of that type were laid down; and, indeed, there was no feeling in favor of submarines in the British navy ten years ago, although it was always held that, if the construction of the class was desired, there would be no difficulty in meeting requirements speedily. The principles of construction for the type were fully understood, and their moderate dimensions enabled the multiplication of any selected type to be rapidly accomplished; but there was no desire to adopt the system for the British navy.

STEAM TURBINES FOR SHIP PROPULSION.

In January, 1894, the first steps were taken by Mr. Parsons and those associated with him to apply his system of steam turbines to ship propulsion. The first trial of the *Turbinia* was made in November of that year. For fully two years the experiments with that notable vessel were continued, 31 trials being made, 7 different arrangements of propellers tested, and final success achieved with three turbines, each driving a shaft with three propellers on each shaft. It is impossible to speak too highly of the courage and skill displayed by Mr. Parsons in this enterprise, which ended in a little vessel of 100 feet in length and 44 1-2 tons displacement attaining a speed of 34 knots. A new era was thus entered upon in ship propulsion, and although (owing to various accidental circumstances) the development of the system has been much delayed, the merit of the work done by Mr. Parsons and the enterprise shown by the gentlemen who formed the original syndicate are now beginning to have their full effect. This new departure was made concurrently with a remarkable development in the use of the "express" type of reciprocating engine in destroyers and small cruisers; but the advantages obtainable in the rotary type of engine were so great that there could be no doubt of the ultimate result of the contest,

especially in ships of the mercantile marine, which, from the conditions of their service, are constantly working at or about the maximum engine power. At full power the turbines have their greatest efficiency, and exceed the best reciprocating engines in economy of steam, whereas their relative economy diminishes as the development of power decreases, and at low powers they become inferior to the reciprocating type.

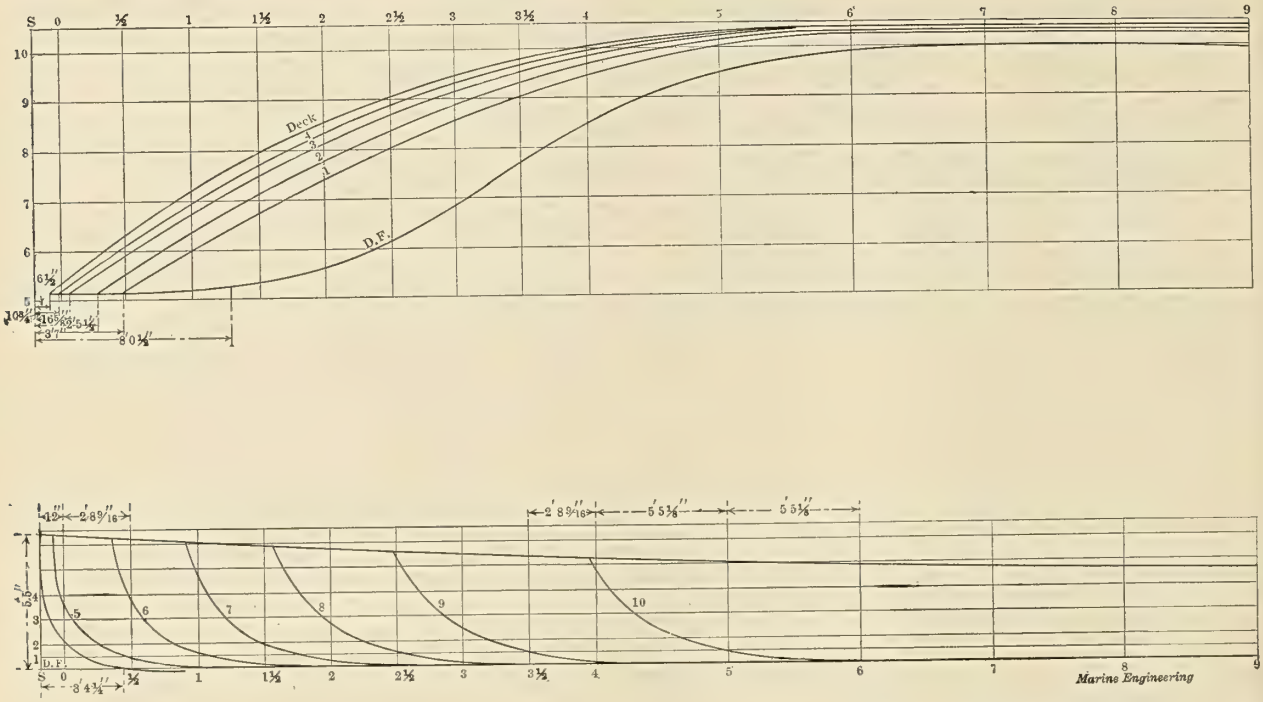
THE BRITISH MERCANTILE MARINE IN 1894.

The British mercantile marine was entering upon a period of expansion in 1894 after a year of unusually small production of new ships. From 1889 to 1892 the gross tonnage of ships launched per annum had been from 1,100,000 to 1,200,000 tons; in 1893 this total fell to about 836,000 tons, and in 1894 again rose to 1,046,000 tons. The largest ships launched in 1894 were the *Caledonia* and *Norman,* about 490 feet in length, 7,500 tons gross and 10,000 to 11,000 I. H. P. The largest sailing vessel launched was the *Pitlockry* of 3,100 tons gross. In 1894, 133 steamers were launched, ranging from 3,000 to 7,000 tons, as against 92 steamers of smaller size launched in 1893. This indicated a tendency to an increase in the size of the individual cargo steamers. The largest vessels of that class on the British register in 1894 were about 480 to 500 feet in length and 8,300 to 8,700 tons gross. That year was also distinguished by the construction of five cargo steamers of the turret type, the first of which had been built in 1892; but the largest of these was only 340 feet in length and of 3,200 tons gross tonnage. One cargo steamer of 10,000 tons was building in 1894, and was launched in the following year. She may be regarded as the predecessor of the modern type of large dimensions which has since grown so much in favor with ship owners. On the Atlantic service the *Campania,* 600 feet in length and of nearly 13,000 tons, had just commenced her service, and her sister ship, the *Lucania,* was completed. During 1894 the *Campania* proved herself capable of maintaining a speed of over 22 knots at sea, with about 30,000 I. H. P. Among cross channel steamers of that date, those used on the service between Dover and Flushing were the fastest, reaching a speed of about 22 knots. They were about 340 feet in length and of about 1,450 tons gross, developing over 8,000 horse power on service. On the Dover-Calais route the largest vessels were about 325 feet in length and of about 1,100 tons gross tonnage, with a speed of about 20 to 21 knots, obtained with 6,500 horse power. Very soon after steps were taken by the City of Dublin Steam Packet Company to construct four new vessels (the *Ulster* class) 360 feet in length, of 2,600 tons gross, which obtained a trial speed of over 24 knots with 9,000 I. H. P. The united kingdom still held the lead in regard to the speed and size of all classes of mercantile steamships, and maintained it up to 1898, when the North German Lloyd took the lead with the *Kaiser Wilhelm der Grosse,* nearly 25 feet longer than the *Campania,* and nearly 2,000 tons greater in tonnage; the maximum speed on service being about half a knot faster than that of the *Campania* and *Lucania.* The *Oceanic* of the White Star line was built almost concurrently with the German ship, and (as the writer has explained more fully elsewhere) the late Mr. Thomas Ismay decided that with then existing subsidies paid to British steamships, it was not possible to work such vessels at a commercial profit at higher speeds than that which had been decided upon for the German steamer. His view was that the least saving in time on the voyage to New York, which would be of practical value, was 12 hours; and that the consequent increase in size, cost, and working expenses could not be made in association with commercial success. It would have involved about 30 per cent. increase in power, and 20 per cent. on the coal bill, besides reducing the freight earning power by about 40 per cent. Consequently, it was decided that, although the *Oceanic* was 60 feet longer than the *Kaiser Wilhelm der Grosse* and of nearly 3,000 tons greater tonnage, the maximum horse power should be only 27,000, corresponding to a speed of about 21 knots on service, and such a reserve of boiler power was provided as insured practical regularity in the period occupied by the voyage. It was no lack of enterprise on the part of Mr. Ismay and his associates which led to this decision, and the lead in speed was virtually handed over to the German lines because there was then no inclination on the part of the British government to give such substantial assistance toward the construction of vessels of exceptional speed as has been recently granted to the Cunard Steamship Company.

Twin screws were coming rapidly into favor for mer chant steamers in 1894, their advantages having been demonstrated in war ships of deep draft during the preceding twenty-five years. In 1878 the writer summarized the experience with twin screws up to date, and warmly advocated their adoption in the mercantile marine. Little was done, however, until ten years later, and the most notable departure was made when the *Teutonic* and *Majestic* of the White Star line and the *Paris* and *New York* of the Inman and International line were constructed (1888-89). Since that date the use of twin screws in all classes of merchant ships has rapidly extended, and enlarged experience has emphasized their great superiority not merely as giving greater safety but more efficient propulsion.

MATERIALS OF CONSTRUCTION IN 1894.

Mild steel of the quality which the British Admiralty began to specify for war ships in 1875 had practically superseded iron for all classes of ships long before 1894. In that year 98.6 per cent. of the new steam tonnage was built of steel, and only 1.2 per cent. of iron, the latter material being used chiefly for trawlers and very small vessels. A longer interval elapsed with merchant ships than with war ships in making this change of material, partly because up to 1891 mild steel was dearer than iron of the qualities commonly used, and partly because there were lingering doubts as to the trustworthiness of steel and its relative corrosion in sea water. The Allen liner *Buenos Ayrean* had been built of mild steel by Messrs. Denny as early as 1879, and as experience increased, so the new material gained in favor. Its good working qualities, uniformity of strength, great ductility and excellent behavior in cases of collision, grounding, and other accidents, all tended to establish it in favor, and experience up to date has been so satisfactory that there is, even now, no general desire to introduce any substitute for mild steel. The use of steel castings, instead of heavy iron forgings, for important parts of the structure



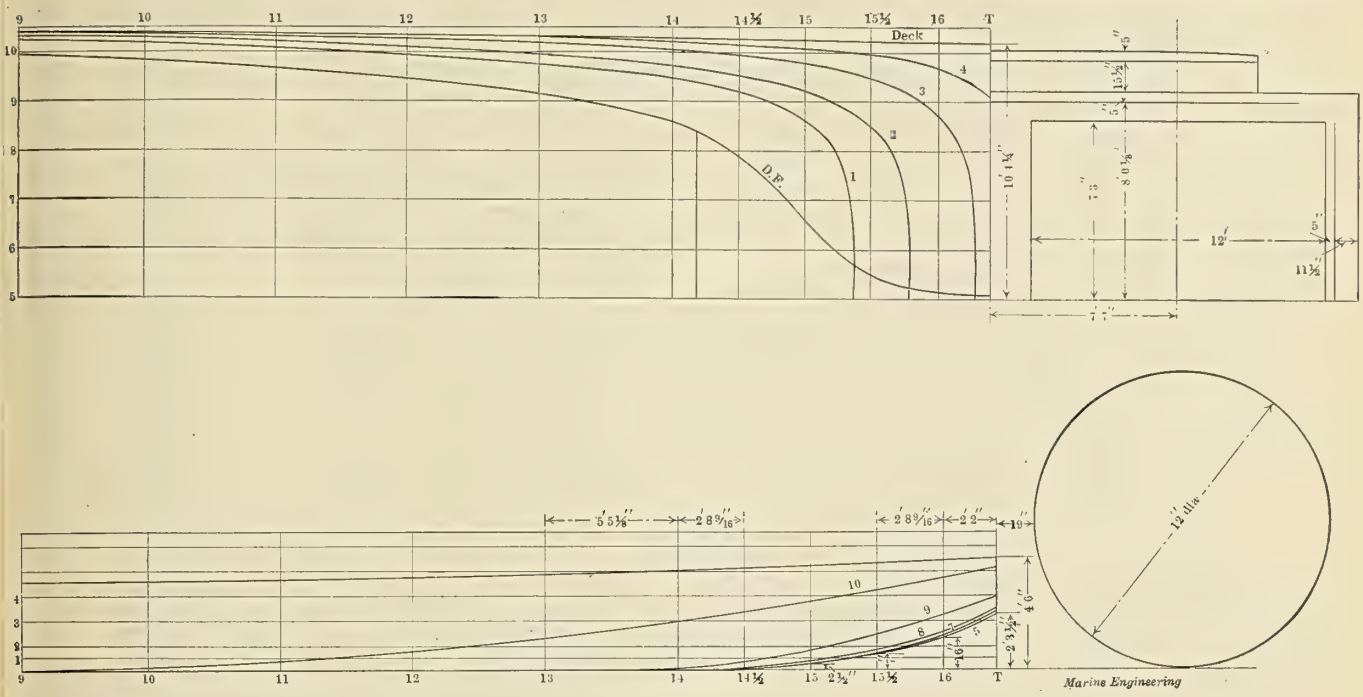
LINES OF THE SHALLOW DRAFT STERN WHEEL

such as stems, stern posts, shaft brackets, rudder frames, began about twenty years ago; by the year 1894 they had come into common use. For war ships with ram stems, large rudders and out board shafting, the use of steel castings has effected remarkable economies in both the cost and the time of manufacture. Enlarged experience has enabled manufacturers to obtain castings of complicated and difficult sectional forms, tending to considerable reduction in weight and to improved fastenings and attachments to other portions of the hull. Looking back upon the history of this particular application of mild steel (in which, owing to the writer's association with the Elswick firm during the period 1883 to 1885, he had an intimate personal connection), it is most singular to note how shipbuilders were for a considerable time prepared to condone or minimize defects in iron forgings; whereas in regard to steel castings they insisted upon severe tests and the most careful examination before acceptance. For example, if the falling tests regularly imposed upon steel castings had been applied to iron forgings, there can be no doubt that, in many instances, the latter would have utterly failed. But many of those who offered the most strenuous opposition to the use of steel castings never suggested that iron forgings should be similarly tested. In passing it may be added that the work done by British investigators and manufacturers in recent years in the improvement of steel castings—a work in which Mr. Hadfield of Sheffield has borne a most distinguished part—appears to justify the hope that in the future it will be possible to substiture steel castings, subjected to a special heat treatment, for many portions of ship structures where steel forgings are now used. Here, indeed, is a field of promise which has long been in view, although its exploration has been deferred; and if the dream that furnace treatment and chemical composition can be substituted for many mechanical processes of pressing or hammering can be realized in practice, then great further economies of weight and cost should be possible.

ALUMINUM FOR SHIPBUILDING.

Prior to 1894 there had been discussions of the possibility of using other materials than steel in special classes of ships. Aluminum and its alloys found most favor, but the use of certain bronzes was also advocated. In 1892-93 two small aluminum launches were built at Zurich, and in 1894 another aluminum launch was at work on the Thames. In that year Messrs. Yarrow built a second-class torpedo boat of that material, and several yachts were similarly constructed. In all cases considerable economies of weights were obtained, but the alloy used proved to be wanting in durability when exposed to the action of sea water. The broad conclusions reached on the basis of this experience were, that while pure aluminum had not the requisite strength, or working qualities, for the purposes of shipbuilding, the alloys obtained up to 1894 were wanting in durability. Messrs. Yarrow have not proceeded further with the system; nor has the French navy continued to use it. It has been alleged, recently, that aluminum bronzes have been obtained which combine ductility and good working qualities with non-corrodibility in sea water. It does not appear, however, that any extended use has been made of the material, but for internal fittings in ships, for some portions of the machinery and for superstructure there can be no doubt that, at least, in special classes of vessels, there may yet be a future for such alloys.

(To be continued.)



STEAMER SASKATCHEWAN, BUILT BY HUDSON'S BAY COMPANY, CANADA.

MARINE ENGINEERING DATA CARD. NOVEMBER, 1904.

NAME—Saskatchewan. NATIONALITY—Canadian. TYPE—Stern paddle wheel.

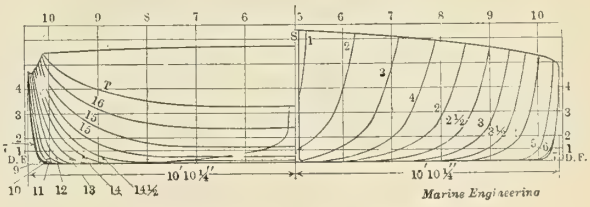
DESIGNER—Marine Iron Works, Chicago, U. S. A.

LAUNCHED—1904. BUILDERS—Hudson's Bay Company. OWNER—Hudson's Bay Company.

Length over all	105 ft. 0 ins.
" of hull	90 " 0 "
Beam	22 " 0 "
Width over guards	25 " 0 "
Depth	3 " 9 "
Draft, loaded	24 "
Displacement	90 tons
Engines:	
Type	double high pressure
Cylinder diameter	9 ins.
Stroke	42 "
Valves	balanced piston
Length of pitman	16 ft.
Wheel:	
Shaft, diameter	5 1-2 ins.
Wheel, "	12 ft.
Number of buckets	12
Length "	14 ft. 6 ins.
Width of each bucket	14 "
Revolutions	35
I. H. P.	117
Speed with load	10 miles
" light	12 1-2 "
Boilers:	
Number	1
Type	locomotive firebox
Diameter	48 ins.
Length	17 ft.
H. S.	666.22 sq. ft.
G. S.	16.02 " "
Steam pressure allowed	180 lbs.

STERN WHEEL STEAMER SASKATCHEWAN, FOR THE NORTHWEST.

The latest addition to the fleet of shallow-draft steamers, owned and operated by the Hudson's Bay Company of Canada, the *Saskatchewan,* was recently built by that company from plans furnished by the Marine Iron Works. She is a stern wheel paddle steamer, 90 feet length of hull, and with a load draft of 24 inches.



BODY PLAN OF THE SASKATCHEWAN.

The main deck is inclosed for carrying freight, while on the upper deck is a saloon with accommodations and state rooms for several passengers.

The Hudson's Bay Company was incorporated A.D. 1670, and with a knowledge gained through an active experience of two hundred and thirty-five years in hand with unlimited resources and equivalent energy, has most successfully covered the waters of the extreme north and northwest territories of Canada. The company's map indicates about two hundred important forts and stations; its principal offices being located in Winnipeg. The company furnishes excellent transportation by its own steamers and fleets of boats navigating all the

principal lakes and streams throughout the territories not traversed by railways. The many difficult features of operation, at times conflicting conditions, have all been successfully met by the very capable and experienced force in charge of their various boat lines.

Although the *Saskatchewan* is one of the smaller of their river steamers, she is worthy of especial mention as being built by the Hudson's Bay Company from model plans and specifications furnished by the Marine Iron Works, Chicago, Ill., who also made the entire and complete outfit for driving machinery, with auxiliaries, special deck equipment, ironing for the hull, and all the necessary fastenings.

STEAMER SASKATCHEWAN, FOR THE HUDSON'S BAY COMPANY

The machinery consists of two high-pressure engines 9 inches diameter by 42 inches stroke driving cranks in each end of the wheel shaft. This shaft is 5 1-2 inches diameter and is fitted for carrying 12 buckets 14 feet 6 inches long and 14 inches wide with greatest diameter of 12 feet. At 35 revolutions the engines indicate 117 horse power and give a speed of 10 miles when the vessel is loaded. Steam is supplied at 180 pounds by one locomotive fire-box boiler with 16 square feet of grate surface and 666.22 square feet of heating surface.

The performance of this boat is, indeed, most creditable to the designers and builders.

Coal-Handling Machinery.

BY JOSEPH C. HOSHER.

Machinery for handling coal is rapidly being installed in almost every branch of industry where coal is used as a fuel, for the necessity of labor-saving machinery in this line is generally appreciated. For the past decade the production of coal in the United States has been increasing about 4 per cent. annually, till that for 1903 reached the enormous figures of 367,000,000 tons, with a valuation of the product of $390,000,000.

This increased production has necessitated the introduction of labor-saving machinery in every branch of this vast industry. Coal mining is now done largely with improved machinery. The means of transportation has been augmented and millions have been invested in the equipment of railroads, making it possible by increasing the capacity of cars from forty to eighty tons, to carry coal at a profit on the basis of 3-10ths of one cent per ton mile, whereas ten years ago coal could not be carried at a profit by railroads at less than 5-10ths of a cent per ton mile and yield a profit. Water rates, likewise, have been reduced by building vessels of large capacity, ranging from 3,500 to 8,000 tons, and by discharging the cargo by machinery. With many of these specially-designed vessels, when the discharging is carried on throughout by automatic machinery, it is possible

to reduce the expense of discharging the cargo to less than one cent per ton.

The grab bucket is used in large discharging plants, and has the usual capacity of 2 1-2 tons. In an ordinary lift the grab bucket will make a trip, taking out the vessel and depositing in storage its load, in thirty to thirty-five seconds. A single tower will discharge, under ordinary circumstances, 1,200 to 1,500 tons in a working day of ten hours, and with four towers working over four hatches a 5,000-ton cargo can be unloaded in twelve hours.

The saving of time in the discharge of vessels is a large consideration to the owners, as the estimated gross earnings of a 5,000-tons capacity ship should be about $300 per day. For this reason the vessel owners always make a liberal allowance for prompt discharge, and it is fair to assume that the improved machinery, which is capable of discharging a ship's cargo in a single day, earns for its owner, in a rebate from the charter price per ton, a sufficient amount to justify him to install the very best discharging machinery possible, and the earning capacity of the ship is increased by an amount represented by the income of the days saved while his vessel would otherwise lie idle.

Machinery of this character, while it does extremely heavy duty and its requirements are exacting from the nature of the work, must be built strong and durable. Many builders have abandoned the idea of constructing anything but the best, as it has been found from sad experiences that only the machinery built of the best material and along safe lines is economical to the purchasers. Those who have purchased light machinery because it was cheap, have paid very dear for their experience, and many plants where cheapness in first cost was the chief consideration, have since been rebuilt.

The purchasers in many instances were not to blame, as the business of coal-handling machinery had hardly passed through the first twenty years. The necessity for efficient machinery has been so keenly felt that now, with ingenious devices, the cost of handling the coal is very much lower than manual labor could do the same work for. This idea having been taken up by some very able and patient men, they have adjusted suitable machinery to the conditions of the times, with the result that a large amount of machinery has been built which is saving time, labor, annoyance from labor organizations, and paying handsome returns for the investments. Coal-handling machinery is practically in its infancy. There is not a single commodity with such vast tonnage that the handling of it by machinery is in such a crude state. It is fair to assume that less than 10 per cent. of the coal produced in the world is handled by machinery. In many of the sea ports of the world, coal is now being handled the same as was done a hundred years ago. In the port of Genoa, Italy, with the cheap labor of that country, it costs thirty-eight cents per ton to discharge coal and land it on the dock. In Yokohama, Japan, about the same price, and in Manila, P. I., forty-five cents per ton. Cheap labor cannot compete with improved machinery, and it will be but a question of time when many of the sea ports of the world will have coal-discharging plants, which will thereby bring to the users of coal a reduction in its price, by the introduction of labor-saving machinery.

Launch of the Italian Battleship Regina Elena.

The first-class battleship *Regina Elena,* of the Italian navy, was launched on June 19 at the royal yard of Spezia. This ship is the first of four similar vessels recently ordered by the Italian government, and is of the *Vittorio Emanuele* type, which was widely discussed in the technical world a few years ago. The purpose of the designer, Mr. Vittorio Cuniberti, was to combine in a moderate displacement of 12,625 tons, the defensive and offensive power of a battleship, with the speed of the cruiser. The principal dimensions will be found in the accompanying table.

The hull is of steel throughout, and the stem and stern posts and propeller brackets are of cast steel. The armor is face-hardened. The motive power consists of two sets of triple-expansion engines designed to develop 20,000 I. H. P., and 28 Belleville water-tube boilers. The designed speed is 21.5 knots, and with a bunker capacity of 2,000 tons of coal the estimated steaming radius, at moderate speed, is 10,000 miles. Electricity is used throughout for lighting, steering, hoisting ammunition and operating turrets.

A 10-inch water-line belt of armor extends the length of machinery space and tapers to 4 inches at the ends. The central redoubt is 8 inches thick and a 3 1-8-inch protective deck is worked in forward; the large turrets have 10-inch armor, and the smaller turrets are 6 inches thick.

MARINE ENGINEERING DATA CARD. NOVEMBER, 1904.

NAME—Regina Elena. NATIONALITY—Italian. TYPE—Battleship.

LAUNCHED—1904. BUILDER—Royal Dock Yard at Spezia. OWNER—Italian Navy.

Length over all	474 ft. 6 ins.
" between perps	435 " 0 "
Breadth, extreme	73 " 6 "
Draft, mean trial	25 " 9 "
Displacement, trial	12,625 tons
Launching weight	5,700 "
Coal supply, maximum	2,000 "
Steaming radius, 10 knots	10,000 miles
Speed, trial, estimated	21 1-2 knots

Batteries:
Main: 2, 12-in. B. L. R. Armstrong; 12, 8-in. B. L. R.
Secondary: 8, 3 1-8 in. R. F. G.; 12, 1 7-8-in. automatic; 4, canister; 2, 3-in. field.

Armor:
Water line belt amidships, 10 ins., tapering to 4 ins. at ends.
Central redoubt.....8 ins.
Turrets:....12-in. guns, 10 ins.; 8-in guns, 6 ins.

Machinery:
2 sets triple-expan. engines 21,000 I.H.P.
28 Belleville water-tube boilers.

Two Armstrong 12-inch 40-caliber guns are mounted on the center line in 10-inch turrets, one gun forward, one gun aft. The weight of the gun is 51 tons, the charge of powder weighs 450 pounds, and that of the projectile is 850 pounds. Each gun has a radius of fire of 300 degrees and is supposed to discharge two shots per minute. The projectile will perforate 13 inches of Krupp armor at 2,000 yards. Twelve 8-inch guns are mounted in pairs in turrets amidships. These guns are Armstrong 45-caliber and weigh 19 1-2 tons; their charge is 122 pounds, and that of the projectile 230 pounds; they will perforate 7 inches of Krupp armor at 8,860 feet.

THE ITALIAN BATTLESHIP REGINA ELENA, LAUNCHED FROM THE ROYAL YARD, AT SPEZIA.

The secondary battery consists of eight 3 1-8-inch 40-caliber guns, 4 in barbetts, two at stem, and two at stern, and four advantageously distributed at sides. These guns are for repelling torpedo boats and destroyers. The rest of the battery consists of twelve 1 7-8-inch rapid-fire guns, four canister guns, and two 3-inch landing pieces. The concentration and intensity of fire in one minute is as follows:

Bow or astern fire.—One piece of 12 inches, 2 shots; weight of the projectiles, 900 pounds; dinamodi, 23,000; eight pieces of 8 inches, 32 shots; weight of projectiles, 4,360 pounds; dinamodi, 115,200; two guns of 3 inches, 40 shots; weight of projectiles, 600 pounds; dinamodi, 8,400.

Broadside firing.—The two 12-inch guns, 4 shots; weight of projectiles, 1,800 pounds; dinamodi, 4,600; six pieces of 8 inches, 24 shots; weight of projectiles, 5,520; dinamodi, 86,400; six guns of 3 inches, 120 shots; weight of projectiles, 1,824 pounds; dinamodi, 25,200.

It is to be remarked that the 6-inch gun generally used for the secondary battery is absent in this ship. It is claimed by Mr. Cuniberti that as the 6-inch gun at 3,000 yards can penetrate but 3 inches of modern armor, this gun is ineffective against lightly-armored vessels at probably battle range, while the chief work they will have to do will be to drive off the smaller torpedo boats, against which the 3-inch guns are almost equally effective.

Dagnino Attilio.

THE PRESIDENT ACTS UPON THE SLOCUM REPORT.

Acting upon the report of the federal commission appointed to investigate the *Slocum* disaster, President Roosevelt, on October 15, gave orders and made suggestions that will revolutionize the United States Steamboat Inspection Service.

His orders are in the form of a letter addressed to Victor H. Metcalf, Secretary of Commerce and Labor, and are as follows:

"My Dear Sir:—I have received the report of the commission of the United States on the investigation of the *General Slocum* disaster, and the report of the Department of Justice, of October 12, recapitulating what has been done by the Department of Justice in

connection with the criminal proceedings taken against various individuals because of their connection with the disaster. I send you herewith both reports. Punitive action by the government can of course only take two forms; one, that of legal proceedings against those either within or without the service, and two, removal from office of those within the service.

"It appears that the Department of Justice has already secured indictments against the master and captain of the *Slocum* and against the managing directors of the Knickerbocker Steamship Company, to which company the *Slocum* belonged, for misconduct, negligence and inattention to duty by the captain and for aiding and abetting therein by the managing directors. Furthermore the Department of Justice has secured indictments against Henry Lundberg and John W. Fleming, the assistant inspectors of the steamboat inspection service, who actually inspected the *Slocum*, for fraud, misconduct and inattention to duty.

"Lundberg had been appointed merely on probation in the service and has been dropped. There can, of course, be no further action taken about Fleming until his trial has been finished, although it does not follow that an acquittal would prevent the department from discharging him from the service.

"In addition, the Department of Justice has secured the indictment of the manager and three employees of the Nonpariel Cork Works, of Camden, N. J., for putting upon the market compressed cork blocks for use in making life preservers, each of which blocks contained in its centre a piece of bar iron weighing several ounces. This last offence was of so heinous a character that it is difficult to comment upon it with proper self-restraint. It appears that the national legislature has never enacted a law providing in set terms for the punishment of this particular species of infamy, doubtless because it never entered the head of any man that so gross an infamy could be perpetrated.

"I suggest that you report this whole matter to congress, transmitting these two reports, and at that time calling special attention to the need of imposing an adequate penalty for the making or selling of defective life saving appliances.

"So much for what the Department of Justice has done in reference to the disaster. But in addition to the men put on trial by the Department of Justice, action should be taken against those employes whose responsibility for the state of things producing the accident has been brought out in the report of the commission.

"According to this report it appears that in addition to the two assistant inspectors who are now on trial, the supervising inspector of the Second district, Mr. Rodie, and the two local inspectors of the Port of New York, Messrs. Dumont and Barrett, should all three be removed for laxity and neglect in performing their duties.

"As regards the conduct of Mr. Rodie, Mr. Uhler dissents from the conclusions of the four other commissioners. I agree with the conclusions of the other four. Laxity and neglect, where the consequences may be as terrible as they have proved to be in this case, cannot be passed over even where there has been good conduct in other respects on the part of the man implicated. Accordingly the three officials named will be removed from the service.

"Moreover, you will please direct their successors in office at once to conduct a thorough examination of the entire inspection force of the Port of New York, with the object of weeding out all the men whom such examination shall show to be unfitted to perform the very arduous and responsible duties of their positions.

"The Supervising Inspector General has at present no headquarters force of special agents, so that it is undoubtedly very difficult for him to exercise any adequate and direct supervision over the various local divisions of the inspection service. In each division he must rely chiefly on the fidelity and energy of the local heads, and if these fail to perform their duty they must be held accountable. He must, however, exercise as thorough a supervision as the means at his disposal allow.

"In order that I may be informed as to the exact condition of the service in all its parts, I direct you to order a searching investigation, in continuance of the investigation of the commission, into the conduct of the central office and of every outside subdivision of the service save that in New York.

"You will also make such changes in the regulations as are recommended by the commission, and you will therefore call a special meeting of the Board of Supervising Inspectors for this purpose. You will also lay before the congress a request that the law be changed in the various particulars recommended by the commission. I wish particular emphasis laid upon the proposal of the commission that there be created by law a special body thoroughly to investigate the laws which are supposed to provide for the safety of passengers on steamboats, especially on excursion boats, where the prime causes of danger are the overcrowding and the flimsy and highly inflammable character of the superstructures.

"Very truly yours,

"Theodore Roosevelt.

"Hon. V. H. Metcalf,
"Secretary of Commerce and Labor."

REPORT OF THE UNITED STATES COMMISSION UPON THE SLOCUM DISASTER.

On June 15, the excursion steamer *General Slocum* was burned and beached in the East river, resulting in the burning to death and drowning of 955 men, women, and children, and the injuring of 175 others. Eight days after, George B. Cortelyou, then Secretary of Commerce and Labor, appointed a commission to investigate the disaster, and not alone to punish those guilty of the causes of this particular case, but to ascertain if changes in the present laws were necessary to prevent a repetition of the disaster. The commission was made up of the following men: Chairman, Lawrence O. Murray, assistant secretary of the department; Herbert K. Smith, deputy commissioner of corporations; George Uhler, supervising inspector general of the steamboat inspection service; Brigadier-General John M. Wilson, U. S. A., retired, and Commander Cameron McR. Winslow, U. S. N.

The hearings of the commission were held in New

York and Washington and the report, covering 62 printed pages, is given herewith in abstract:

"All the upper works of the *Slocum* were constructed of light woods and had been painted and varnished many times, and were, therefore, in a highly inflammable condition. In the construction of the vessel there were no safeguards against fire other than compliance with the regulations as regards the proximity of woodwork to boilers. The vessel had no fire-proof hatches or bulkheads and was entirely built of wood.

"The *General Slocum* was a vessel built to carry a large number of excursionists (2,500 allowed by law), and in her design there was apparently no consideration whatever given to the question of inflammability. In such a vessel a fire, once having obtained fair headway, could not be controlled and the vessel would be quickly consumed, as exemplified in the case of the *General Slocum.*

"There are many similar vessels doing service in the waters of the United States, the construction of which is quite as dangerous as that of the *Slocum,* and unless this kind of construction shall be prohibited or modified by law the safety of a large number of passengers carried by excursion steamers and steamers plying on the inland waters of the United States cannot be assured."

The report shows that the cabin of the *General Slocum* was filled with inflammable material, a large amount of oil being among its contents. It was lighted by electricity, but lamps were filled and burned there, and the crew frequently lighted matches in the compartment. On the morning of the disaster, Walter Payne, the negro porter, filled the lamps in the cabin. As there was not sufficient light he lighted a lamp, using a match; blew the match out and "threw it on the bench." Later, an oiler from the engine room entered the cabin, using as a light an open torch. The commission says on this point:

"The condition of this cabin, with the purpose for which it was used, constitutes one of the essential facts of negligence contributing to the disaster."

The apparatus of the vessel for fighting fire is described at length. The forward valve of the standpipe which was nearest to the place of the origin of the fire was about 30 feet from the entrance to the forward cabin.

"This forward valve and standpipe," says the report, "was supplied with a 100-foot length of cheap, unlined linen hose, costing probably less than 20 cents a foot, age unknown, but probably several years old. The rest of the fire apparatus on the main deck consisted of the after valve of the said standpipe, two hand fire pumps, located respectively in the bow and in the stern, and some 20 fire buckets were used, and the fire buckets were empty."

Upon the discovery of the fire by the crew "the so-called mate, Edward Flanagan," notified the captain and the two pilots, who were in the pilot house, through the main deck speaking tube. He then informed the engineer that the boat was on fire and asked for water on the fire line. With two or three of the deckhands Flanagan took down the linen fire hose. Daniel O'Niell, deckhand, opened the valve of the standpipe forward and turned the water into the hose.

The hose having fallen on the deck in a coil was twisted and kinked and as soon as it was subjected to water pressure it burst in two or three places, and simultaneously the hose itself was blown off from its own coupling where it was connected with the standpipe. Preponderance of evidence shows that no water came from the nozzle of the hose."

The report pays a tribute to Assistant Engineer Brandow, and also to Chief Engineer Conklin, who remained at their posts. It says: "Evidently Brandow did his full duty efficiently and courageously. He was at his post until the vessel was beached, for the engines were kept in motion until a few seconds before striking North Brother island.

The evidence of the pilots was that Captain Van Schaick received the first notice of the fire when the vessel was about four lengths to the eastward of Sunken meadows. He ordered full speed ahead and directed that the vessel be kept on her course. Subsequently he directed the pilot, Van Wart, to beach the vessel on North Brother island."

"The evidence before the commission establishes the fact that the master made no attempt whatsoever to fight the fire, to examine its condition, or to control, assure, direct, or aid the passengers in any way whatsoever. It is alleged that he was unable to reach the place where the passengers were, by reason of the fire, but this is contradicted by the evidence of many witnesses, and is obviously not true.

"An essential fact of negligence is the utter failure of the master to fight the fire or aid the passengers. In a less degree the pilots in the same manner, after beaching the boat and while there were still many passengers on board, failed in their duty to assist and rescue the said passengers. Very little assistance was given or control exercised by any of the officers or crew on behalf of the passengers."

Discussing the origin of the fire, the commission says that the evidence of people on the main deck is to the effect that they knew of the fire at the entrance to Hell Gate. In general, the evidence of people on the upper decks is that the first notice of fire on those decks was before the vessel had passed the middle of Ward's island. One witness testified that he knew of the fire at a point opposite a marble yard at Astoria. This marble yard is a conspicuous object near the entrance to Hell Gate.

"Reviewing the whole testimony," continues the report, "the commission believes that the first discovery of the fire on the main deck was before reaching Ward's island; that the mate, Edward Flanagan, knew of it at about that time, and to the westward of Negro Point Bluff, on Ward's island; and that he at once gave notice to the pilot house of the existence of the fire."

The evidence of the captain and pilots radically disagrees with statements of other witnesses, but the commission says that it is forced by the weight of the entire evidence to the belief that the "statements of the men in the pilot house as to the time when they first knew of the fire are incorrect, and that the evidence of the master and of the pilots as to the position of the vessel in the stream when the fire was first known to them must be disregarded.

"After a careful consideration of the entire testimony

as to the time of the discovery of the fire, the commission is of the opinion that the men in the pilot house had knowledge of the fire before the steamer passed the eastern end of Ward's island.

"The commission therefore believes that the master knew of the fire in time to have beached the vessel either in Little Hell Gate to the westward of the Sunken meadows, or in the Bronx Kills, to the eastward of the Sunken meadows, and to have thereby gained the great and essential advantage of placing the vessel with her stern to the wind so that the flames would be driven forward and away from the passengers, instead of taking a course that inevitably drove the flames rapidly aft, toward the passengers, and delayed the beaching of the vessel for several minutes longer than was necessary."

The commission declares that Pilot Van Wart showed bad judgment and lack of skill in beaching the vessel at a considerable angle with the shore line, thus leaving in deep water all but the bow of the ship, which was in in flames, and affording the passengers who could not swim little opportunity to save their lives. The commission believes that the vessel might have been beached so as to enable passengers to leap overboard and wade ashore.

As to the fire-fighting apparatus on the vessel the report says: "There is a strong probability that the fire would have been controlled had the fire hose been of the required statutory strength. Many of the life preservers were in bad condition, and, while it is probably true that many of these would have supported passengers in the water, the average passenger, seeing one torn, refused to use it or to try others, and the result was as disastrous as if the life preservers had been wholly unserviceable.

"The inefficiency and poor quality of the deck crew of this vessel, doubtless typical of the majority of the crews of excursion steamers," says the commission, "is one of the essential facts that caused the loss of so many lives."

In some detail the commission discusses the duties and responsibilities of the owners of excursion steamers, and then says:

"The commission is of the opinion that the owners of the *General Slocum* are censurable in a high degree for the inadequate and improper conditions prevailing on board this vessel, and that, whatever may be their technical legal liability, they and their executive agents share largely in the moral responsibility for the awful results of this disaster."

The report shows that the operations of the Steamboat Inspection Service at New York were unsatisfactory, inefficient, and negligent in many respects, and recommends thorough reorganization of the force of assistant inspectors. Referring to the work of the supervising inspector in New York the commission says:

"If he did not know of the facts of inefficiency and neglect on the part of his subordinates, or if he knew of them and did not take steps to remedy them, he is equally chargeable with neglected duty. But it is undeniable that the local board at this port did not do its duty. Upon the supervising inspector, therefore, must rest a large share of responsibility for the existence of such inefficiency and neglect."

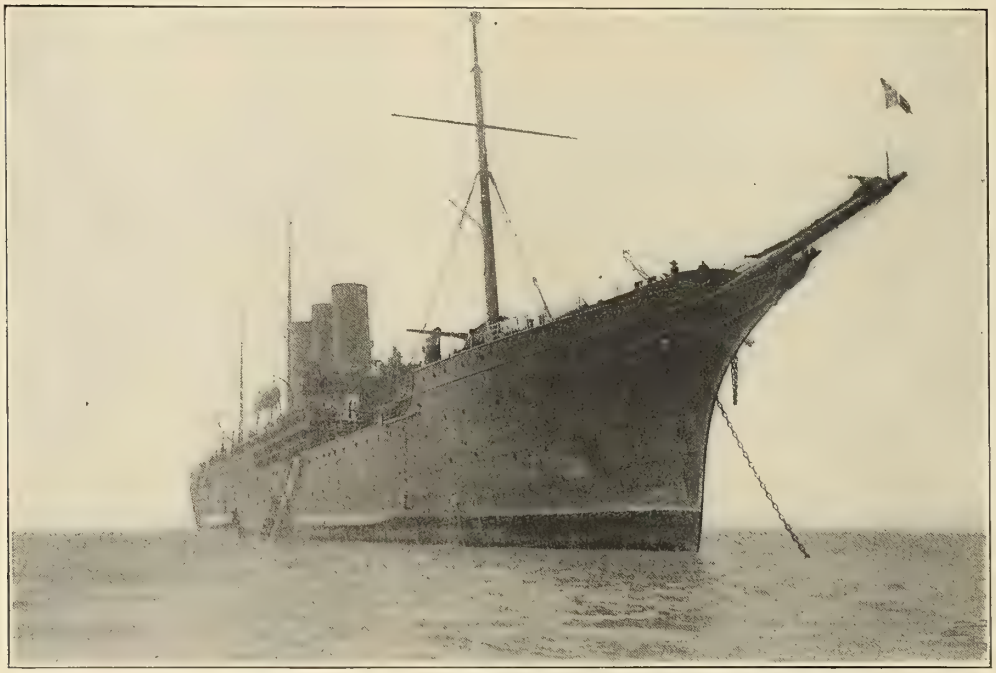
By reinspection of 268 vessels the commission has been able to analyze and consider with great care the actual condition of vessels in the Port of New York. In many instances since the *Slocum* disaster vessels have been re-equipped with new life-saving appliances and fire-fighting devices. The reinspection showed, however, the gross inefficiency of the old system of inspection, there being 33 per cent. of defective or missing life preservers, and 26 and 35 per cent. of defective or missing hose. The commission is of the opinion that the same state of facts applies to boiler inspection.

The commission presents many recommendations relating to the laws and regulations governing the Steamboat Inspection Service. It is pointed out that the present laws relating to safety appliances are inadequate and the commission strongly recommends that the laws relating to the service be amended so as to confer greater power to enforce its commands.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of October 12, 1904, the following degree of completion of vessels building for the United States Navy:

				Degree of Completion. Per Cent.	
BATTLESHIPS.				Sept. 1	Oct. 1.
Ohio	18 knots.	Union Iron Works		99	99.7
Virginia	19 "	Newport News Co.		66.8	68.6
Nebraska	19 "	Moran Brothers Co.		56.7	59
Georgia	19 "	Bath Iron Works		63.3	65.3
New Jersey	19 "	Fore River S. and E. Co.		66.4	69.1
Rhode Island	19 "	Fore River S. and E. Co.		68.9	71.2
Connecticut	18 "	Navy Yard, New York, N. Y.		50	53.59
Louisiana	18 "	Newport News Co.		56.5	59.68
Vermont	18 "	Fore River S. and E. Co.		16.3	21.5
Kansas	18 "	New York Shipbuilding Co.		22.1	26.6
Minnesota	18 "	Newport News Co		39.77	43.8
Mississippi	17 "	Wm. Cramp and Sons		7.71	10.24
Idaho	17 "	Wm. Cramp and Sons		7.47	9.98
ARMORED CRUISERS.					
Pennsylvania	22 knots.	William Cramp and Sons		86.7	90.5
West Virginia	22 "	Newport News Co.		91.62	94.2
California	22 "	Union Iron Works		63	64
Colorado	22 "	William Cramp and Sons		91.2	95
Maryland	22 "	Newport News Co.		89.16	90.57
South Dakota	22 "	Union Iron Works		61	61.5
Tennessee	22 "	William Cramp and Sons		45.74	50.06
Washington	22 "	New York S. B. Co.		41.4	44.7
PROTECTED CRUISERS.					
Chattanooga	16½ kts.	Lewis Nixon		94.62	97
Galveston	16½ "	Wm. R. Trigg Co.		89	91
St. Louis	22 "	Neafie and Levy Co.		48.8	51.1
Milwaukee	22 "	Union Iron Works		57	58.5
Charleston	22 "	Newport News Co.		81.4	83.2
GUNBOATS.					
Dubuque	12 knots.	Gas Engine and Power Co.		58.4	63.9
Paducah	12 "	Gas Engine and Power Co.		53.6	58.9
TRAINING SHIPS.					
Cumberland	Sails	Navy Yard, Boston		66	72
Intrepid	"	Navy Yard, Mare Island		49.1	56.2
TRAINING BRIG.					
Boxer	Sails	Navy Yard, Portsmouth		75	85
TORPEDO BOATS.					
Stringham	30 knots.	Harlan and Hollingsworth		99	99
Goldsborough	30 "	Wolff and Zwicker		99	99
Blakely	26 "	George Lawley and Son		99	99
Nicholson	26 "	Lewis Nixon		99	99
O'Brien	26 "	Lewis Nixon		98	98



RUSSIAN CRUISER LENA, OF THE VOLUNTEER FLEET, AT ANCHOR IN SAN FRANCISCO BAY.

[Photographs by Dana & Petersen.]

Cruiser Lena of the Russian Volunteer Fleet.

BY W. S. ATKINSON.

The cut herewith presented shows the Russian auxiliary cruiser *Lena,* Captain Berlinsky, which escaped the watchful eye of the Japanese at Vladivostok, and, it is reported, at the high speed of 19 knots steamed across the Pacific, entering San Francisco harbor September 11, 1904, saluting the forts and warships on her way to an anchorage off the Union Iron Works. The captain made the statement that he was obliged to come here owing to the bad condition of the ship's boilers. At first this was considered by many a strategic move to gain time in port, but a thorough inspection of the boilers by the local United States inspectors soon set aside all rumors as to the *Lena's* unexpected visit to the Golden Gate.

Orders were soon received to disarm the *Lena;* for this purpose the ship, escorted by the U. S. S. *Marblehead,* was taken to Mare Island navy yard, where all that went to make her offensive to Japan was safely stored in the government magazines. At present she is moored alongside one of the yard docks, which is patroled by U. S. marines, while a small launch protects her from all harm on the outboard side. No one is permitted to board her without her commander's consent.

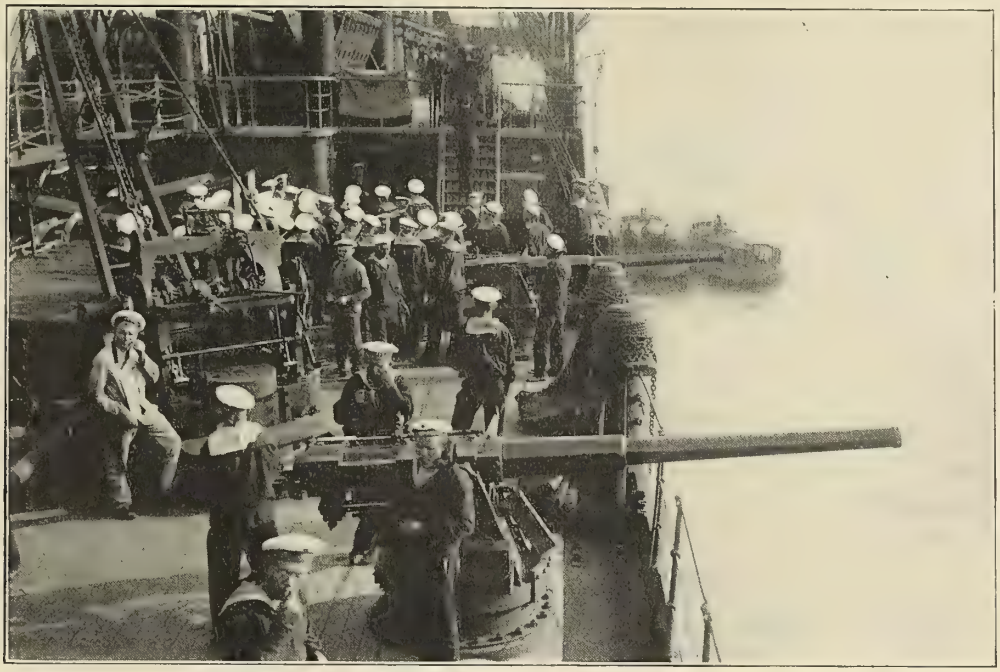
The *Lena,* formerly the steamship *Kherson,* was built for the Russian Volunteer Fleet Association of St. Petersburg, in August, 1896, by R. & W. Hawthorn, Leslie & Company, Ltd., Newcastle-on-Tyne. She is classified for Lloyd's highest rating and is known as a first-class twin screw passenger steamer, having three masts, schooner rig, with a maximum speed of 23 knots per hour. Some of her principal dimensions are as follows: Length over all, 493 feet; extreme beam, 54 feet; depth, 37 feet, and load draft, 24 feet.

When in the merchant marine service, accommodations are provided for 148 first-class passengers, 60 third-class passengers and 1,444 imigrants, a total of 1,652 passengers.

Power is furnished by two sets of triple expansion engines of the vertical inverted type, having three cylinders of the following diameters, 36, 57 and 92 inches. The common stroke is 54 inches. The Marshal type of valve gear operates all steam valves. There are two cast steel propellers 17 feet 6 inches diameter, 24 feet 6 inches mean pitch, and of 98 square feet projected area per wheel. Steam is supplied by 24 Belleville water tube boilers at a pressure of 250 pounds, reduced to 160 pounds at the throttle. The total heating surface is 35,300 square feet and the total grate area 1,130 square feet. The boilers are arranged in three watertight compartments of eight boilers each, and those of each compartment lead to a stack 96 feet high above the keel by 9 feet 6 inches diameter.

The vessel is illuminated throughout by electricity and provided with two powerful search lights. All quarters have artificial means of heating and ventilating. Extensive refrigerating and evaporating plants form some of the valuable auxiliaries to be found on modern ships. Her present armament consists of 15 rapid fire breech loading rifles of 120 millemeters caliber. The crew, consisting of 650 officers and men, still remain on board their ship, 24 being allowed shore leave each day.

There is much keen interest among San Francisco ship builders over the fact that the captain has been authorized to convert the ship into a modern transport, and make all repairs, alterations, etc., necessary to put her in first-class condition. Bids have been called for and all local yards are working night and day preparing plans, specifications, etc.



VIEW ON THE STARBOARD GUN DECK OF THE RUSSIAN VOLUNTEER CRUISER LENA.

The plans, as projected, require a complete rearrangement of officers' quarters, the fitting up of main and lower decks for the accommodation of 2,000 troops and 250 crew, the installation of new electric, heating and ventilating systems, new anchors, windlass, deck winches, search lights (in military tops), submarine lights, etc., 24 Belleville water tube boilers with uptakes, breeching, stacks, feed pumps and piping.

Going into the engine room the plans are even more extensive, calling for four new circulating engines and pumps, auxiliary condensers, feed water heaters, filters, auxiliary, steam and exhaust piping throughout, machine shop and the complete overhauling of main engines.

The new evaporating plant with distillers, pumps, etc., is to have a capacity of 50 tons boiler water and 30 tons drinking water per 24 hours. The present armament is to be replaced by 11 rapid fire breech loading rifles of 120 millimeters caliber, 12 of 75 millimeters, eight of 47 millimeters and 4 1-pound guns for military tops.

Magazines are to be fitted with complete flooding system throughout. No definite reason can be ascertained from the officers of the *Lena* why so much machinery is to be renewed or to the future movement of the ship after being converted into a transport.

THE ENGINEER'S FORCE ON THE LENA—THE CHIEF ENGINEER IS MARKED WITH AN X.

Quarterly Shipbuilding Returns.—The Bureau of Navigation reports 328 sail and steam vessels of 40,374 gross tons built in the United States and officially numbered during the quarter ended September 30 as follows: Wooden sail vessels, 130, of 24,363 gross tons; wooden steam vessels, 179, of 7,130 gross tons. Steel vessels constructed in this period are all fitted with steam power to the number of 19, of 8,881 gross tons. All but four vessels of 409 gross tons, which were built on the Great Lakes, were constructed on the Atlantic and Gulf. During the corresponding quarter of last year, 310 sail and steam vessels of 66,023 gross tons were built in the United States and officially numbered. There is a decrease of over 6,000 tons of wooden steam vessels, an increase of about 12,000 tons of wooden sail vessels, and a decrease of about 31,000 tons of steel vessels.

TEMPORARY DRY-DOCKS FOR RAPID CONSTRUCTION.*

BY V. E. TIMONOFF,[1] M. AM. SOC. C. E.

GENERAL CONSIDERATIONS.

As maritime commerce extends to the most remote regions of the world, the need of finding everywhere facilities for thorough repairs of damaged merchant vessels makes itself more and more felt. Many vessels have had to be abandoned because there were no facilities and appliances for their repair at nearby landing places. This happens less frequently with war ships, but even the navies of the world may sometimes be in need of repairs when far from harbors with special and permanent repairing facilities.

On the other hand, modern appliances for repairing ships are very costly and cannot be installed everywhere. It is therefore of interest to try to find whether the same object can be attained by more simple and less costly means, though less conveniently than with perfect facilities.

It is the object of this paper to indicate one of the possible solutions of this problem. The method proposed by the writer seems to him to promise satisfactory results should local conditions permit its application.

REPAIRING SHIPS IN HARBORS PROVIDED WITH DOCKING FACILITIES.

In commercial or military ports various means are used for important repairs to floating ships, for scraping the hull, for repainting, etc., according to each case, and, especially, according to the dimensions and importance of the vessel. They are accomplished either by heaving the ship down or grounding it on a keeling dock, by raising it on a lifting slip, by towing it into a repairing or floating dock, or, finally, by lifting it by an elevating apparatus. The appliances for repair most generally used and best adapted to vessels of all dimensions are dry-docks. They consist, as is well known, of fixed basins, which can be emptied and so maintained after the vessels have been brought into them. The construction of dry-docks generally presents serious difficulties because of the pressures to be sustained and the tightness required.

A stiff floor and side walls are built, which form on the inside a succession of banks or steps to facilitate the propping of the vessel. Stairways and slideways are provided for the easy access of the workmen and materials. Capstans, mooring posts, tackle and all kinds of appliances are placed to allow of easy handling of vessels and caissons, and, finally, derricks are arranged for managing heavy pieces such as screws and shafts.

The water in the dock, whether due to infiltration or filling, is collected in drains and led by conduits into drain wells, from which it is pumped into the sea. The ships in the dock rest on keel and bilge blocks and are supported by props and shores. To allow space for the rudder while the vessel is in the dock, a pit, called the rudder pit, is frequently made in the floor.

The location of docks is so determined that vessels may be able to enter with safety and security, as the operations of entering and leaving, especially with large ships, are quite delicate. The docks are, therefore, placed not far from the quays where the ships are usually stationed.

Dry-docks, entrances to which are not provided with mitered gates, are closed either by floating caissons or by caissons rolling on the floor of the dock. A floating caisson acts as a movable and tight screen, which can be floated to uncover the opening it closes, and which can be raised and lowered by admitting water into the floating chamber. It is brought into the dock and depressed before the dock is drained; after the emptying of the latter it is raised by discharging the water used in lowering.

The writer has enumerated the principal features of an ordinary dry-dock to show in a stronger light the simplifications which he proposes for temporary dry docks.

REPAIRING SHIPS WITHOUT DOCKING FACILITIES.

If the repairs to be made on a ship are not very considerable, and if the damaged parts are not too far from the line of floatation, the repairs can sometimes be made successfully while the ship is afloat.

By displacing the ballast on the vessel the damaged portion can be raised above the surface of the water and the repairs be made. This method is applicable within very narrow limits only, so much the more so since an unsymmetrical load on large vessels, especially on war ships, is often dangerous and may cause their overturning.

Sometimes it is possible to surround the damaged part by a floating caisson which fits snugly against the sides of the vessel and permits of keeping the place to be repaired partly dry. Work in such caissons is naturally slow and inconvenient. The limited dimensions of the caisson do not permit the easy introduction of plates. Besides, the shape of certain parts of a vessel does not lend itself to the use of a floating caisson, and, if the damaged parts are deep, the pumping becomes very difficult, if not impossible.

Finally, the building of the caisson itself is complicated, laborious and slow work.

In tide water unimportant damages can be repaired by stranding the ship on a sand bank at high tide and so exposing part of the vessel at low tide. This method is applicable only when the damaged part is located between the high and low water levels.

Without proceeding further to examine the various expedients which may in certain cases give good results and not be applicable in others, it must be admitted that the universal method which is able to meet all conditions is the dry-dock. By giving access to all parts of the vessel it makes possible the concentration of a great number of workmen at the place of damage, permits the handling of plates and other parts of all dimensions, and, finally, insures continuous and safe work.

NECESSITY FOR RAPID CONSTRUCTION OF TEMPORARY DRY-DOCKS.

The somewhat hasty examination of methods employed in repairing ships afloat will, however, suffice to show the necessity there may be for the rapid construction of temporary dry-docks, in the interest of the merchant marine as well as of war vessels. With this in

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*Paper read before the International Engineering Congress, St. Louis, Mo., October 3 to 8, 1904.

view, all indispensable work must be reduced to a minimum, and any parts of a dry-dock existing in one form or another in the given locality must be utilized to the fullest extent.

If a natural or artificial basis can be found where the dry-dock can be located, the excavation of a special basin may be dispensed with. If pumps are available sufficiently powerful to maintain the dock in a condition dry enough for continuous work in spite of more or less considerable infiltration, it will not be necessary to secure a perfectly impermeable floor and side walls, and the least required tightness will suffice.

It will be unnecessary also to surround the dock with walls more or less vertical so that walls of loose stone only, without mortar, may be used, which can be laid in place by unskilled labor and by means of cars and boats. The blocks, which in the ordinary dry-dock support the weight of the vessel and require a very solid foundation to transmit it to the ground, can also be omitted, as will be shown later. Finally, the floating caisson may be replaced by a gate of a rougher kind and easier construction.

The problem of building a temporary dry-dock, undoubtedly, has several solutions for each special case encountered by the engineer, and it is far from the intention of the writer to enumerate all methods by which a dry-dock can be rapidly constructed. As stated above, he merely desires to indicate a method proposed by him for a particular case and which appears to be extremely simple and cheap.

A PROPOSED SYSTEM OF TEMPORARY DRY-DOCKS FOR RAPID CONSTRUCTION.

The fundamental idea of the system of temporary dry-docks proposed by the writer is based on the reservoir dams as built of loose stones in California. These dams, as is well known, have been invented by practical men without technical training but gifted with the genius of their race. The pioneers of civilization in the gold mining states needed great stores of water. To build dams in the rocky gorges of the mountains nothing but stone was available. The use of mortar for binding the stones together was impossible because of the lack of cement and skilled labor. It was then attempted to build reservoir dams of stones thrown on the ground as riprap without mortar and, from the point of view of rapid work, cheapness, and strength of the dams, remarkable results were obtained. A dam 210 feet high, exceeding in height the greatest dams built of masonry laid in cement mortar, is now being built of loose stone in California. The possibility of building walls of loose stone, able to resist such high water pressures, enables us also to use this method of construction for dry-docks.

In an existing basin, or near a shore sheltered from the waves, or finally, in a recess of the ground, an enclosure is made by means of a dike of loose stones. Figs. 1 to 4 indicate the different cases which may occur according to local natural or artificial conditions. This dike consists of a stone prism and is covered from the outside with a layer of earth to increase its tightness. Such a dam, compared with any other kind, has the following advantages:

1. *Rapid Construction.*—The stones are dropped just as they are brought to the work without sorting and without mortar, and, as they can be transported in cars or boats, the working space can be enlarged almost at will and the number of workmen, who may be unskilled laborers, may be correspondingly increased. A speed of construction is obtained with such a loose stone dam which cannot be reached with any other materials. If, for instance, the dam had to be built of sheet piling and stones, timber of large dimensions and special pile drivers would be required; it would further be necessary that the ground should permit the driving of sheet piling all around the dam, and, if all these conditions were fulfilled, rapid work could not be done without risking the tightness of the work.

2. *The Tightness of a Loose Stone Dam can be Progressively Increased According to the Needs.*—A loose stone dam covered with a layer of earth can be made tighter by simply increasing the thickness of the protective layer. In all other systems the dam must from the start have such dimensions as will secure the necessary tightness, which leads to exaggerated dimensions which cannot be determined from the beginning. A loose stone dam covered with earth is built of the least dimensions, and afterwards, according to the indications of its workings, the thickness of the earth layer can be increased, if required, without exceeding the necessary limits.

3. *Easy Removal.*—To remove a loose stone dam or to make an opening in it, unskilled laborers supplied with wheelbarrows for the upper portion and a dredge for the lower will suffice. Into the enclosure made by a dam as described and having a sufficient depth of water a vessel can be floated through an opening left in the dam for this purpose. This opening is then closed in the way the dam was built or by more perfect means.

A pumping station located on the shore or on the dam will accomplish the draining of the dock and the lowering of the vessel. To protect the hull from damage which may be caused by resting the vessel on the ground, a deep layer of sand is deposited on the bottom of the dock. This layer of sand replaces the blocks of the ordinary dry-dock. As the water falls, due to the action of the pumps, the vessel gradually compresses the sand and thus prepares the bed for supporting its weight. This is distributed with much regularity over a very great area.

Actual experience in stranding war and merchant vessels of high tonnage on sand banks exposed at low tide, to make urgent repairs, has proved that the strength of the hull is not impaired by this expedient. This has not been tried with large modern vessels of more than 10,000 tons displacement, but even for vessels of such dimensions there is no reason to expect that serious trouble will be caused by their resting on a layer of sand instead of a series of blocks. Such trouble will be of small importance since the repairs generally required are not far from the line of floatation. It will, therefore, not be necessary to drain the dock completely; it will suffice to simply lower the water level enough to uncover the damaged part. The sand foundation will thus, in such cases, have to sustain only a fraction of the weight of the vessel. For damages located deeper, it may be equally unnecessary to drain the dock completely, but it may suffice to lower the water level enough to make it possible to build around the damaged spot a sand dam and then to drain this secondary enclosure.

To float the vessel out of the dock after repairing, an opening is made in the dock of sufficient size to let the vessel pass. In a dam of loose stone and earth this work is very simple. The method of procedure has been indicated above. The amount of material to be removed can be reduced to a minimum by floating the ship out at high water. Had the dam been built of piles and sheet piling, these would have to be removed for their full height without being able to utilize the advantages of a high tide. The dam can easily be closed for new repairs.

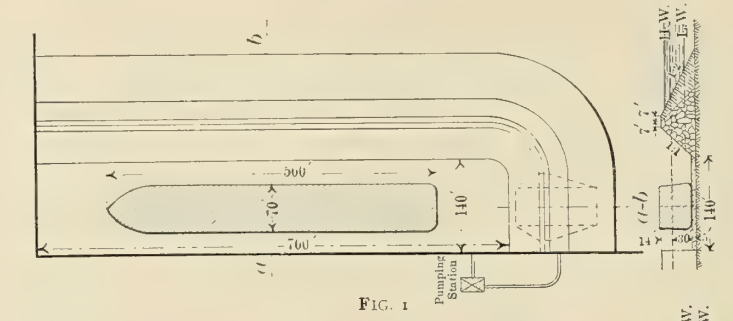


FIG. 1

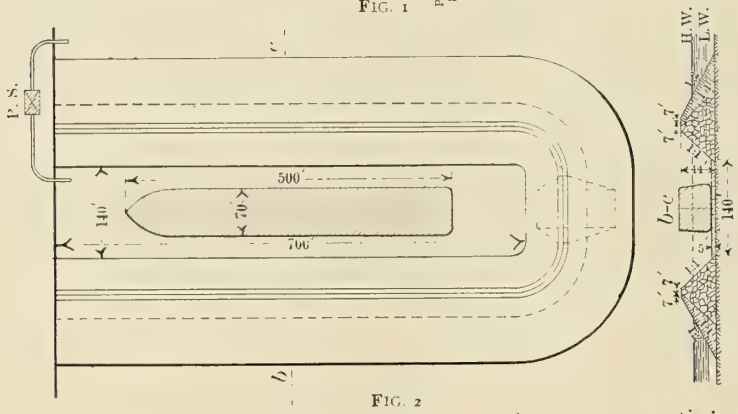


FIG. 2

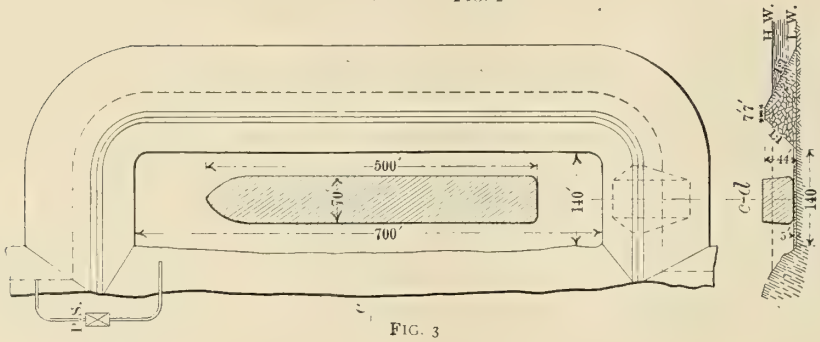


FIG. 3

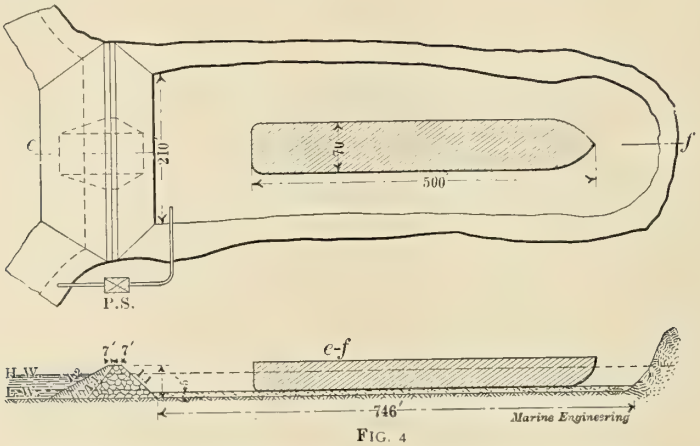


FIG. 4

PROPOSED FORMS OF TEMPORARY DRY-DOCKS THAT CAN BE RAPIDLY BUILT.

If the temporary dock has to be used frequently enough, and if sufficient time is available to build a more perfect gate, this can be done while the dock is in use. This object could be attained, for example, by the

construction of a gate with the aid of wooden caissons. It can be built in a separate place and rapidly be put into position without stopping the work in the dry-dock for a long time. To close the entrance of the dock, a boat of convenient dimensions may be adapted, which, while not being as perfect as a real floating gate, will much facilitate the handling of the opening and closing of the dock and still give sufficient tightness.

As a final improvement a floating or rolling dock gate may be built, and, should it be found necessary, blocks to support the weight of the vessel may be built on special foundations.

APPLICATION OF THE PROPOSED SYSTEM.

The temporary dry-dock for rapid construction, proposed by the writer, consists, as described in the above, of an enclosure made partly by the shore, natural or artificial, and partly by a dam of loose stone and earth. It can be emptied and kept dry by a pumping station working continually, if required. The function of the keel blocks is performed by a deep foundation layer of sand. The opening through which the vessel is floated into the dock is closed by a fill of loose stone and earth which is afterwards removed by simple means to let the repaired vessel out. A dock of such construction can be improved further without stopping the work in the dock.

The successful application of this system of construction depends on the character of the ground. If the ground is too permeable, if it is a fissured rock, and if, therefore, the natural bottom of the dock may be liable to very considerable infiltration exceeding the pumping capacity, the difficulties to be overcome are very great. But in the majority of cases the same conditions will be encountered, as far as pumping is concerned, as in the sinking of large trenches, and the success of the enterprise cannot be endangered.

The location of the dock should be so chosen as to make the perimeter of the dike and the amount of work to be done as small as possible. If the shore forms a bay in which the water is deep enough or can be easily deepened it will preferably be chosen. (See Fig. 4). If not, there may be a corner of a floating dock (Fig. 1), or a site near a sheltered shore. These conditions are, however, of a character which cannot be generalized. Tides can facilitate the use of the proposed system by making possible considerable reduction in the volume of the dam to be removed to let the vessel out after repairs have been completed.

CONCLUSIONS.

Merchant vessels are always and war vessels are sometimes in need of repairs of damages sustained by them far from ports provided with all modern facilities for docking and repairing. A dry-dock is the most convenient appliance for repairing. Means should be devised to construct dry-docks rapidly and cheaply with materials which may be at hand at localities distant from the centers of production. The dry-dock system proposed by the writer, consisting of a dam of loose stone and earth and a sand foundation replacing the blocks, seems to fulfill, for local conditions where it is applicable, the requirements of quick construction, simple work and cheapness, while it procures for vessels the facilities to make all necessary repairs.

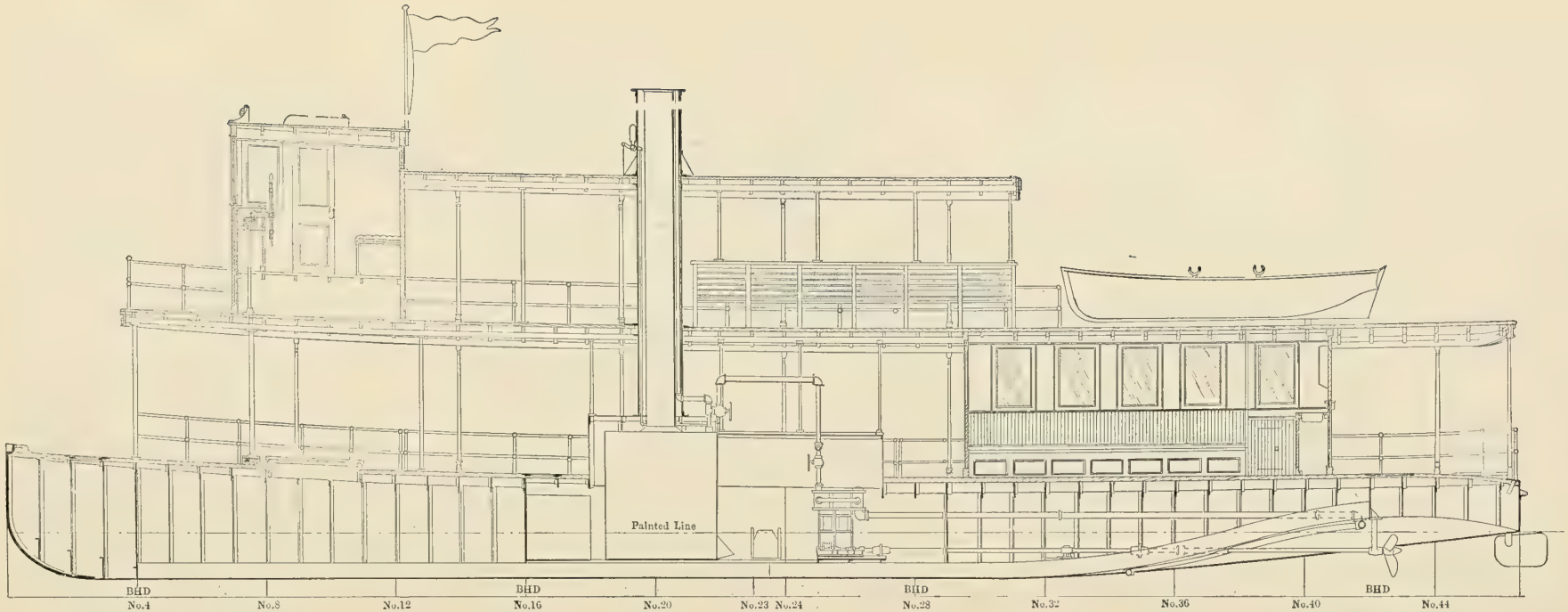
Wreck of the Drumburton.

The fine four-masted British ship, the *Drumburton*, recently ran on a reef during a fog on the California coast, and though she went ashore while light, and there was little wind blowing, she settled so securely on the rocks that it is impossible to save her.

BRITISH SHIP DRUMBURTON, AGROUND OFF POINT SAN PEDRO, CAL.

On September 3 the *Drumburton* left San Francisco in ballast bound for Puget Sound to load cargo for Valparaiso. When she had passed out of the Golden Gate the fog closed in and a treacherous sea carried the ship on the sharp rocks of Point San Pedro, 10 miles south. The bottom was punctured in several places, and the ship settled quickly into a saddle of rocks from which nothing but the storms of winter will ever dislodge her. All that may be saved are the sails, rigging, and other probable equipment.

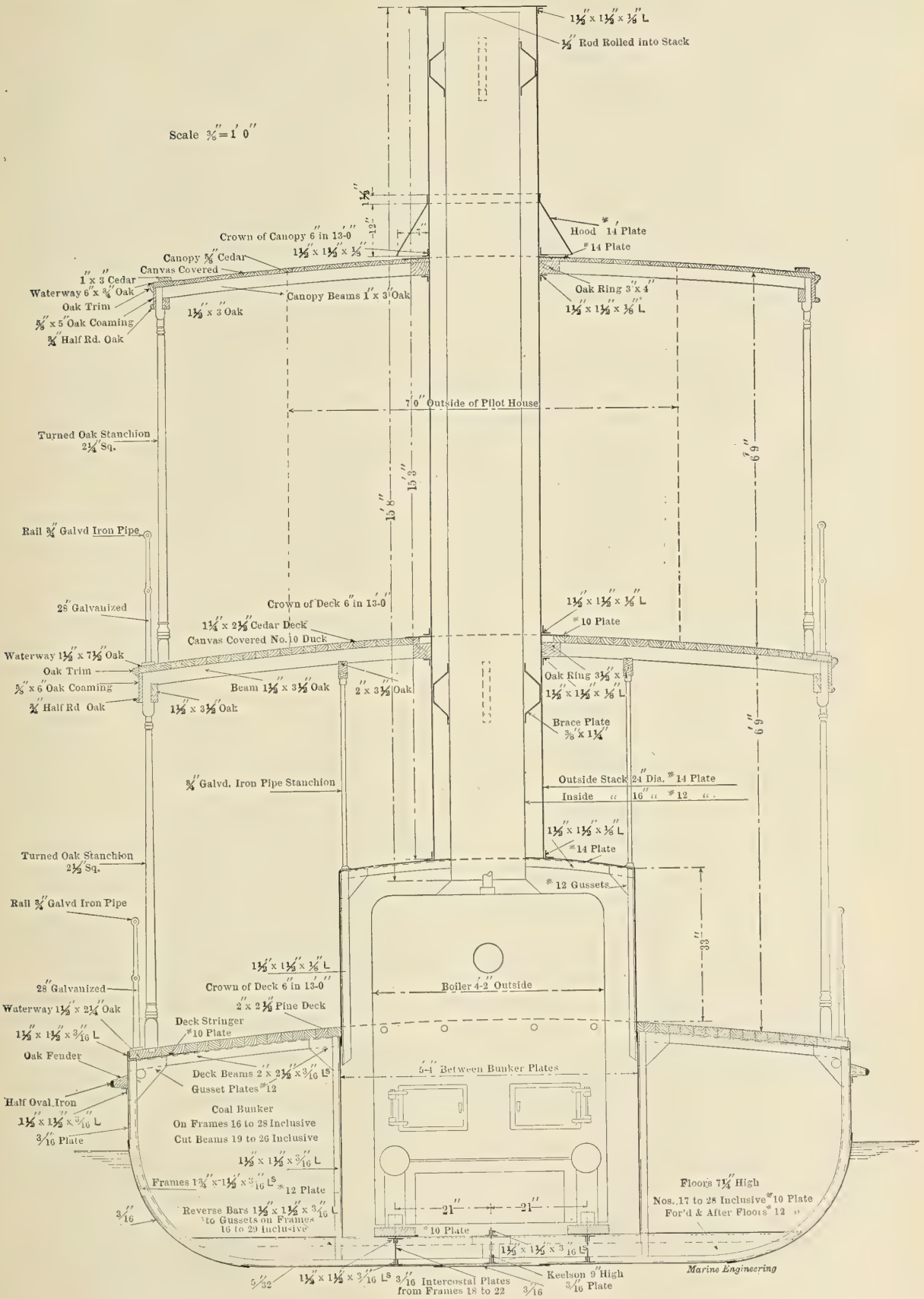
Great Lakes Shipbuilding.—During the past month orders for 21 new, large ships have been placed with the yards on the great lakes.



INBOARD PROFILE AND DECK AND HOLD PLANS OF THE NEW SHALLOW-DRAFT TUNNEL PROPELLER STEAMER MACUSPANA.

Shallow Draft River Boat Macuspana.

The opening up of new country to navigation by means of shallow draft river steamers is creating a good demand for this type of vessel. The Racine Boat Manufacturing Company, Muskegon, Mich., has just completed the designs and is now carrying on the construction of a 70-foot twin screw vessel of this class, for Mr. Ignacio Carrenza of Mexico, for service on the Macuspana river. The draft is limited to 26 inches when loaded with 15 tons freight and fuel. The hull is built very light—the lightest consistent with strength—and abaft is in the form of a tunnel for placing the


1½" x 1½" x ⅛" L
½" Rod Rolled into Stack
Scale ⅜"=1' 0"
Hood * 14 Plate
* 14 Plate
Crown of Canopy 6" in 13-0"
1½" x 1½" x ⅛"
Canopy ⅝" Cedar
Canvas Covered
1" x 3" Cedar
Waterway 6" x ¾" Oak
Oak Trim
⅝" x 5" Oak Coaming
¾" Half Rd. Oak
Canopy Beams 1" x 3" Oak
1½" x 3" Oak
Oak Ring 3" x 1"
1½" x 1½" x ⅛" L
7' 0" Outside of Pilot House
Turned Oak Stanchion 2¼" Sq.
15' 8"
15' 3"
6' 9"
Rail ¾" Galvd Iron Pipe
28" Galvanized
Crown of Deck 6" in 13-0"
1¼" x 2⅝" Cedar Deck
Canvas Covered No. 10 Duck
1½" x 1½" x ⅛" L
* 10 Plate
Waterway 1½" x 7½" Oak
Oak Trim
⅝" x 6" Oak Coaming
¾" Half Rd. Oak
Beam 1½" x 3½" Oak
2" x 3½" Oak
1½" x 3½" Oak
Oak Ring 3½" x 1"
1½" x 1½" x ⅛" L
Brace Plate ⅜" x 1¼"
¾" Galvd. Iron Pipe Stanchion
Outside Stack 24" Dia. * 14 Plate
Inside " 16" " * 12 "
1½" x 1½" x ⅛" L
* 14 Plate
Turned Oak Stanchion 2½" Sq.
* 12 Gussets
Rail ¾" Galvd Iron Pipe
33"
1½" x 1½" x ⅛" L
28" Galvanized
Crown of Deck 6" in 13-0"
Boiler 4-2" Outside
Waterway 1½" x 2¼" Oak
2" x 2½" Pine Deck
1½" x 1½" x 3/16" L
Deck Stringer * 10 Plate
Oak Fender
Deck Beams 2" x 2½" x 3/16" LS
5-4" Between Bunker Plates
Gusset Plates * 12
Half Oval Iron
1½" x 1½" x 3/16" L
3/16" Plate
Coal Bunker
On Frames 16 to 28 Inclusive
Cut Beams 19 to 26 Inclusive
1½" x 1½" x 3/16" L
Frames 1¾" x 1½" x 3/16" LS * 12 Plate
Reverse Bars 1½" x 1½" x 3/16" L to Gussets on Frames 16 to 29 Inclusive
21" 21"
Floors 7¼" High
Nos. 17 to 28 Inclusive * 10 Plate
For'd & After Floors * 12 "
3/16"
* 10 Plate
1½" x 1½" x 3/16" LS
5/32"
1½" x 1½" x 3/16" LS
3/16" Intercostal Plates from Frames 18 to 22
3/16"
Keelson 9" High 3/16" Plate
Marine Engineering

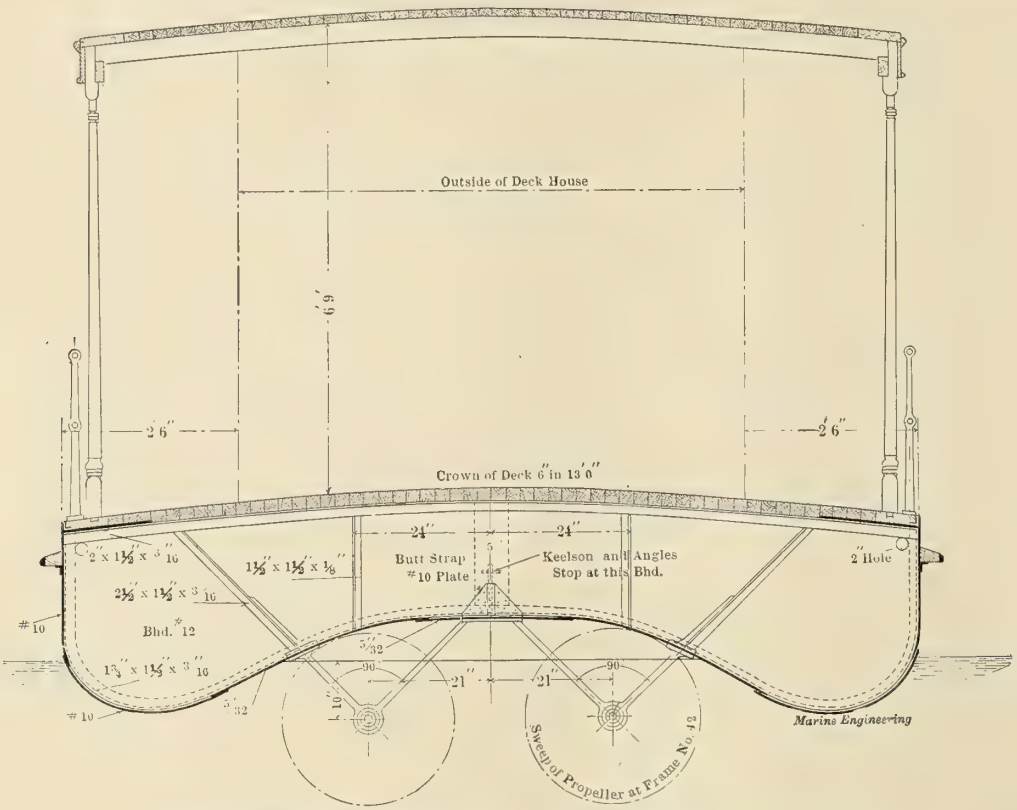
MIDSHIP SECTION OF SHALLOW-DRAFT STEAMER MACUSPANA, BUILT BY THE RACINE BOAT MANUFACTURING COMPANY.

propellers and giving them a free run of water. There are four transverse water-tight bulkheads on frames No. 4, 16, 29 and 42, the latter being the location of the propeller struts. These bulkheads divide the boat into five self-contained sections, each of which is to be built to ship independently ready for assembling in Mexico. The machinery is placed midships with deep coaming about hatch, but not inclosed. The space forward and abreast the machinery is available for cargo, and aft is placed a saloon fitted with extension berths and a galley and toilet. The forward hold is available for freight, while on either side of the boiler are coal bunkers with a cubic capacity of nearly 300 feet.

The scantlings of the boat are well shown in the plans. The dimensions of the hull are: Length, 70 feet; beam, molded, 13 feet, over fenders, 14 feet; draft, loaded with 15 tons, 26 inches.

The hull is built of steel throughout; all plating is galvanized. Fore and aft seams are lapped and single riveted, while thwartship butts are double riveted with butt straps on the inside.

The machinery consists of a pair of fore-and-aft high speed engines, with cylinder diameters 4 1-2 and 9 inches and with a stroke of 6 inches. The piping is so arranged that either engine may be worked independently, but they both may be worked together by means of a throttle valve and auxiliary throttle. Piston rods, connecting rods and valve rods, eccentric rods, etc., are to be of best mild steel. The crank pin brasses, crosshead brasses and the reverse connections are to be of hard bronze metal. When running full power the engines will indicate 50 horse power. The condenser is of the Racine improved sectional type, hung on the tunnel bottom as shown on the drawing, page 518. An independent air pump is fitted: the feed pump is of the simplex vertical type. The propeller wheels are of a naval composition and the struts and stern tubes of naval bronze. A Racine boiler with 12 square feet of grate surface and 325 square feet of heating surface, designed for a working pressure of 225 pounds per square inch, is to be installed. All the pressure piping is of heavy steel and all valves are to have bronze bodies and of extra heavy pattern where necessary. The other equipment includes bilge pump, injector, firing tools and special wrenches, and all fittings are for salt water service.



SECTION AT BULKHEAD 42, ON THE MACUSPANA, SHOWING TUNNEL AND PROPELLERS.

Russian Cruiser Askold.

After the naval battle of August 10 between the Russian and Japanese fleets off Port Arthur, the Russian cruiser *Askold* sought refuge in the friendly port of Shanghai, China. The condition of this ship as she was moored in the Whangpo river is illustrated by engravings made from photographs taken at the time. In the full view is shown the general damage to the entire upper works of the ship. At the point on the water line directly above the cross is an opening made by a 6-inch armor-piercing shell. The manner in which the superstructure was riddled by the exploding of a 6-inch shell is shown in the nearer view of the launch. The hull was pierced through and through above the water line by several heavy shells, most of which created fearful carnage and destruction.

RUSSIAN CRUISER ASKOLD, AT ANCHOR OFF SHANGHAI, AFTER THE BATTLE OF AUG. 10.

RUSSIAN CRUISER ASKOLD, SHOWING THE DAMAGE TO DECK AND LAUNCH, RESULTING FROM THE EXPLOSION OF A SHELL.

[Photographs from Leslie's Weekly.]

Marine Engineering

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AT last, after many official dates for the sailing of the Russian Baltic fleet have come and gone without the vessels appearing on the high seas, it is announced by cable that the fleet is about to pass through the Sound of Denmark into the North Sea and proceed to the Far East. The ships comprising this fleet are a mixture of the new and the old, some of them the pride of the Russian navy. Briefly stated, they consist of seven battleships, the oldest one launched in 1891 and the latest launched in 1902. The armament of six of these battleships consists of four 12-inch guns and one of them of four 10-inch guns. The second piece of the primary battery is a 6-inch gun, twelve of them being fitted on each of the four newest vessels and eight, six, and eleven guns of this caliber being mounted on the remaining ships. The cruisers are of the smaller class, the largest as well as one of the oldest being of 8,500 tons displacement. Compared with the naval force which Japan may oppose, Russia is superior in gun power. However, the uniformity of the Japanese fleet, the remarkable training in war, the unapproachable discipline, the brilliant record of successful engagements, will throw the balance of power in favor of Japan. In addition Japan is fighting in her own waters, near her base of supplies, while the Russian fleet may be intercepted before it reaches a Russian port, and at the end of a 14,000-mile journey sadly in need of repairs.

It is stated that the fleet will be divided and proceed to some point of rendezvous in the Indian ocean by two routes, the larger ships by way of Cape Good Hope and the smaller vessels, including the torpedo boat squadron and the small gun boats, by way of the Suez canal. Each fleet will be accompanied by several colliers, supply, and repair ships, and already thousands of tons of coal are under way for use en route. Several of the Hamburg-American steamships have been chartered for this purpose. The speed of the fleet, of course, is that of the slowest vessel, and it is doubtful if the trip can be made at an average of over 10 knots, which, with the unavoidable delays for coaling and repairs, means that the voyage will take about ninety days. Arrangements have been completed, it is reported, through French authorities, to permit the squadron to take on board at Seignon sufficient coal to carry to the nearest Russian port, namely, Port Arthur or Vladivostok.

The final destination of the fleet forms the greatest source of conjecture. Assuming that General Stoessel is still in command at that time, it is probable that the Baltic fleet will sail directly for Port Arthur, to join the remnant of the once splendid Russian armada in that harbor. This juncture would, indeed, prove serious to the Japanese, and it is probable that their command of the seas would be lost. Another possibility is that the Russians will sail directly to Vladivostok for necessary repairs and replenishing before taking to sea for battle. This harbor becomes ice bound in December, but if necessary, a channel will be kept open. It is doubtful if Admiral Togo could spare sufficient of his fleet from Port Arthur to intercept the Russians while he has to maintain the blockade of that port. The Russians would thus be in a position to prey most seriously upon Japanese commerce, and to devastate the coast, chosing their own time to attack the Port Arthur squadron.

These, however, are improbable possibilities, in that all signs point to the speedy reduction of Port Arthur, and especially under the pressing danger of the coming fleet Japan would, if necessary, direct her entire energies against the reduction of that stronghold. It appears impossible that the

fort can hold out for three months longer under these conditions. Also, the raising of the siege by the Northern army now appears a forlorn hope. Therefore, it will be possible for Admiral Togo to attack with his entire squadron the Russian fleet in the open seas, and to minimize its fighting capacity by destroying or capturing as many vessels as possible. He cannot expect to annihilate the entire fleet, as such an exploit is unknown in naval annals, and the escaping vessels would probably reach Vladivostok.

From our point of view this last naval move of Russia appears to be a desperate one, much like the despatch of Admiral Cervera to Cuba, and soon Russia may be relegated, temporarily at least, to a third-class naval power.

BY President Roosevelt's action on the report of the United States commission of investigation upon the *General Slocum* disaster the supervising inspector and the two local inspectors of the Port of New York have been dismissed from the service, and he has instructed that a thorough investigation of the United States Steamboat Inspection Service be undertaken at once. This service has for a long time been looked upon as one of the weakest in the government, principally due to the fact that congressional laws which created it and defined its scope of action were enacted many years ago, at a time when marine engineering was practically in its infancy. While the Board of Supervising Inspectors may recommend changes in the rules, and the Secretary of Commerce and Labor has authority to incorporate such changes, amendment of the statutes can only be secured by national legislation. Bills have been introduced in several sessions of congress giving power to revise this service, and shipping interests have worked hard to secure such legislation, but with no avail; the same laws are still in force. It is impossible to have an efficient system based on inefficient, antiquated laws. The commission's report is full of suggestions of necessary changes in the Steamboat Inspection Service, changes which have before been pointed out many times; however, the present recommendations, following close in the wake of the awful calamity of the summer, will, it is to be hoped, finally rouse congress to its responsibility for the present state of the service. A sad condition of affairs it is, indeed, which requires such a sacrifice of human life to bring about necessary reform.

The personnel of the Steamboat Inspection Service is not what we should desire. In the first place, the force of inspectors in New York is numerically too small to handle the regular work of inspection in any thorough and efficient manner. Again the inspection has been carried on, under directions from the head of the service, entirely by assistant inspectors, whose standing is an indefinite one at best. The local inspector must sign his subordinate's report, and thereby place himself responsible for the inspection, concerning which he has absolutely no personal knowledge. Again, under existing statutes, the inspectors have no power after condemning faulty or inefficient outfit to see that it is destroyed. Power should be given them to revoke a vessel's certificate at once on discovering any violation of the steamboat inspection law. The above are but a few of the many apparent defects in the statutes, but those which appear most conspicuous as contributing toward the *Slocum* disaster. Concerning the inadequacy of the rules governing boilers and machinery we have frequently drawn attention in these pages, and will not repeat, although the incongruous features become more glaring each year. We keenly regret that the individual has been held responsible for the workings of an absolutely inefficient law, and that the supervising inspector of New York has been removed.

IT is a pleasure to present to our readers on another page Rear-Admiral Melville's views on triple-screw propulsion. As engineer-in-chief of the United States navy the admiral for many years contended for triple screws in high-powered war ships. He keenly perceived the structural and strategic advantages of the triple screw, and the sessions of the Board of Construction were taken up with many a contention for and against this type, with the sturdy admiral in its favor. Under Secretary Tracy he was successful in so far as securing its adoption for the two commerce destroyers *Columbia* and *Minneapolis*. However, he was defeated in his desires to make the adoption general. The action of Germany, as the result of competitive manœuvring trials with twin-screw and triple-screw vessels, to adopt the triple screw in all future designs, and also the incidents of the present war in demonstrating the vulnerability of a ship's propeller and steering gear when under the enemy's fire, will doubtless determine other powers to adopt the triple screw. It has been used almost altogether in British turbine vessels, so that the one-time prejudice against it is now gone.

Freedom of the Seas; Unusual Adventures of a Merchantman.

BY E. A. SUVERKROP.

We were lying stern on to the long mole at Palermo, Sicily, loading oranges and lemons for the London market. On our starboard side was moored the *St. Asaph,* of London, and on our port the *Excellent,* of Sunderland. The latter had finished loading below and was taking on a deck load of oranges and lemon peel in barrels.

I was leaning over the taffrail, kidding the second engineer of the *Excellent.* "What idiot gave the name of *Excellent* to that old coal coffin? Where are you bound this trip?"

"We are bound for Philadelphia," he replied, ignoring my first question.

"You'll never pass the capes" (Gibraltar), said I.

Well, the next day a dapper little official came on board and tacked an elaborate document in Italian on our foremast, which turned out to be an arrest; the ship was held with a perishable cargo, pending the result of the legal proceedings.

Our old man (he was part owner) swore long and loud at the delay, but he was a man of more than words, as I well knew. He had been a blockade runner during the war between the north and the south, and later had run arms and ammunition to a dozen South American countries in times of revolution.

All the morning the winches rattled merrily away stowing the last cases below, and by 2 o'clock the loading was done and the hatch covers were on. Owing to the leaky condition of the donkey boiler we had steam on the one main boiler to supply power for the winches.

About 6 o'clock the skipper came on board and at once sent for the chief engineer. After a talk with him the second was sent for; the interview with him over, I, the third, was requested to lay aft. When I reached the cabin the old man motioned me to a seat and began.

"Mr. Suverkrop, you may not know it, but I am part owner of this craft, and every day we are kept in this port means money out of my pocket, which I can ill afford; our cargo is perishable, and I am liable for my share. We have been arrested, as you know; the charge is merely a blackmailing scheme, and by the time it is settled in court the cargo will be rotten and I will be ruined. I have been very busy to-day forming my plan of action. I suppose you know I have just had the chief and second here; they have both refused to take the vessel out to-night. Do you know how to handle the engines?"

"Yes, sir, I do," I replied.

"Will you take her out to-night at midnight?"

"I will, sir, if you give the orders. I know there is only one captain to one vessel (which is a wise provision of providence), and if you pass the word, it is you who will have to stand by the consequence, good or bad."

"Well spoken, and if we come out of this all right I will make you a present of a twenty-pound note. I want you to be ready at midnight, with every ounce of steam the boiler will carry. The warps astern will be cut and we will then have a clear, straight course out into the Mediterranean. We may be chased; there is a dirty little dago gun boat about, but as she can only steam 8 knots to our 9 I think we can shake her off before she does us much damage. Go now and get ready, for I rely on you alone as far as the engine room is concerned."

Fame had come at last, so off I trotted well pleased with my new rôle. Thinks I: "Suverkrop, old man, if you keep on in the straight and narrow path of virtue you may yet be hanged for pirarcy on the high seas."

My first job was to take the clappers out of the bells of the engine-room telegraph, both below and on the bridge. This done I had the four fires cleaned, went into the bunkers, sent down enough coal to last one watch, and had a lot more run over to the doors, so that it would not be necessary for the coal passers to go into the bunkers for 24 hours at least. By 11 P.M. I had good big fires in all the furnaces, 55 pounds of steam on the gauge (she blew off at 60), and had started to warm the engines up.

The engine-room skylights had been closed and covered with a double tarpaulin to keep the lights in the engine room from being seen from the shore.

At a quarter to twelve the old man came below.

"How are things, Mr. Suverkrop, are you all ready?"

"Everything is ready, sir, and the sooner we get out so that I can lift the skylights the better; we can hardly breathe down here."

"Well, be ready for 12, sharp. Good night."

At 11:59 the pointer on the engine-room telegraph wagged silently to and fro and stopped at "stand by." I answered promptly and ordered the ashpit dampers off and the furnace and smoke-box doors closed. This done the telegraph moved to "full ahead." At a sign from me the man on the boiler top opened the main stop valve full, while I opened the throttle a little at a time and round came the cranks, faster and faster. The old engine seemed like a thing of life, to enjoy the unusual sensation of having all the steam it could take care of.

I leaned back against the bulkhead under the ventilator to catch a breath of air; above the throb of the engines and the rattle of the fire irons in the stoke hold I could hear the sounds of the men on deck, and suddenly the dull boom of a gun borne on the night wind. Then the voice of the second mate shouted down the ventilator, "Give her all you can, Mr. Suverkrop; we are being chased, but so far their shooting is pretty wild."

The sound of the guns became more frequent but fainter as we outdistanced them, and at length the mate again called down, "You can lift the skylights now, sir."

So we steamed on down the African coast, intending to drop in at Orau, in Algeria, to coal, for we were short when we left Palermo. However, when we got abreast of Orau the chief told the skipper we had enough coal to take us to Gibraltar, where we could get our supply much cheaper. So we stood off to the northwest for Gibraltar.

We were due to reach there about midnight, and when I went on watch at that hour, for the middle watch from 12 to 4 is usually allotted to the third engineer, the loom of the lights of Gibraltar could be clearly seen in the sky to the northwest. The chief, whose watch preceded mine, told me we would get into Gibraltar about 2 A.M., and that he was going to set away the fire in the donkey boiler on deck, which had been repaired during our run up the coast.

The old man had been into Gibraltar many times and would run in without the aid of a pilot. As I stepped from my room to the engine room I noticed the lights of a small steamer a mile or so on our starboard quarter. I went below, and about 2 A.M. the telegraph rang, "stand by," "slow," "stop," "full astern," "stop." I heard the rattle of the anchor chain in the hawser pipe and knew the "mud hook" was down and we were safe at anchor.

Ten minutes later I was standing under the ventilator when I heard a confusion of shouts on deck and the second mate shoved his head into the hood of the ventilator and shouted, "All hands on deck, we are being run into."

I thought he was kidding, and paid no attention; the next moment there was the sound as of a mighty explosion. I remember thinking it was the donkey boiler, and hoping it had taken the chief along with it, for he had treated me scandalously since I earned and got the twenty pounds from the captain. Then through the half-open starboard bunker door there gushed a great torrent of water; for a moment I was at a loss what to do. Just then the chief appeared at the head of the engine-room ladder. "Ye domd Yankee fule, whit way are ye staunin there like a stuck pig; can ye no pit th' dunky pumps on th' bilges?"

That assembled my wool-gathering wits; while I was busy with the bilges the cable was slipped and the ship was beached.

When we were safely on the bottom we went into the bunker and discovered a clean cut below the water line about three inches wide by four feet long. The carpenter cut us a lot of pine wedges and wrapping them in cotton waste we drove them into the breach, so that by the time they were all in and the cotton had had a chance to swell she did not leak a bucketful an hour.

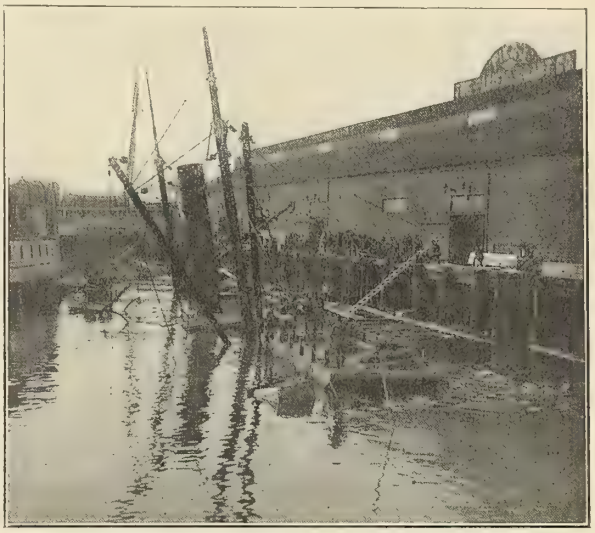
Next day we found that the *St. Asaph* had arrived at Gibraltar two days before we had; the boat whose lights I had seen was the *Excellent*. Her skipper was dodging around outside waiting for a pilot, and on seeing us go in he thought he would save pilotage and follow. But he was unacquainted with the treacherous nature of the bottom of Gibraltar harbor, which is a series of flat table lands with deep valleys in between.

A few minutes after we had cast anchor they had also cast anchor, evidently at the edge of one of these table-lands, and when the pull had come on the anchor (with the go astern order which is always given when coming to an anchorage), it had dragged into the valley, and there not being enough chain out for the anchor to catch, the vessel became unmanagable and drifted beam on to the *St. Asaph's* bow, tearing away her fore foot and rammed a hole in her own port side so large that she began to sink at once. She then drifted bows on to our starboard side and finished up by sinking. So she did not get past the capes after all.

We lay in Gibraltar for about ten days—it took the Spanish machinist that length of time to put on a 5-8-inch plate 8 inches wide by 5 feet long, with about 35 5-8-inch cap screws in it. We eventually discharged our cargo all right at Fresh Wharf, London, and then went to Wallsend shipway for repairs. But that's another story.

Sinking of the Steamship City of Topeka.

On the evening of September 11, the steamship *City of Topeka*, owned by the Pacific Coast Steamship Company, mysteriously sank at her dock at Seattle, Wash., while loading cargo destined for Alaska ports. The loading was being rushed in order that the vessel could sail the following day, and about $50,000 worth of miscellaneous cargo had been put aboard when it was suddenly discovered that the steamship was rapidly going down by the head. At the same time she took on a heavy list, and in alarm the stevedoring crew, the only persons aboard, promptly climbed on to the dock. The vessel continued to sink at a rapid rate, and within half an hour was lying at the bottom, with only the upper part of her smoke stack and masts above water.



STEAMSHIP CITY OF TOPEKA, SUNK AT HER DOCK.

At low tide next morning her decks were just awash. Divers were at once sent down to ascertain the cause of the accident, and to begin the work of removing the cargo, so that operations to raise the craft could be commenced at the earliest possible moment.

The cause of the vessel's sinking, if known, has not been divulged, although it is broadly hinted that an open port hole or broken dead light is responsible for the disaster. A coffer dam is in course of construction around the submerged vessel, and it is thought that she will be again floated inside of a few weeks. The damage to cargo and salvage operations will make the loss easily amount to $100,000. All work is being conducted with the utmost secrecy, and a high fence has been built around the scene of operations to prevent spectators seeing what is going on. The vessel is iron hull, 746 net tonnage. She was built at Chester, Pa., in 1884.

Annual Meeting of the Society of Naval Architects and Marine Engineers.

The twelfth annual meeting of the Society of Naval Architects and Marine Engineers will be held on Thursday and Friday, November 17-18, 1904, at 12 West 31st street, New York, N. Y. The sessions will be held morning and afternoon of each day, and on Friday

evening, the 18th, the annual banquet will be held. A list of papers to be read is as follows:

1. Simple Methods in War Ship Designs a Necessity. By George W. Dickie, member of council.
2. The Semi-Globular Naval Battery. By Anson Phelps Stokes, associate.
3. The Sea-Going Battleship. By Commander William Hovgaard, Royal Danish Navy, member.
4. Some Further Notes on the Performance of the Torpedo Boats of the United States Navy at Sea. By Lieut.-Commander L. H. Chandler, U. S. Navy.
5. The Position of the Center of Lateral Resistance. By L. E. Bertin, member.
6. Some Recent Experiments at the United States Model Basin. By Naval Constructor D. W. Taylor, U. S. Navy, member of council.
7. Coaling of War Ships at Sea—Recent Developments. By Spencer Miller, member.
8. Time Allowance for Steam Yacht Races. By Ex-Engineer-in-Chief George W. Melville, U. S. Navy, Vice-President.
9. On the Rules of Lloyd's Register for Building Yachts to Class. By George Stanbury, member.
10. The Shipping and Shipbuilding of Puget Sound. By Frank W. Hibbs, member.
11. Maintenance of Machinery in Merchant Ships. By Robert Haig, member.
12. High Speed Gasoline Launches. By Clinton H. Crane, associate.
13. Speed and Power of Recent Motor Boats. By Alpheus A. Packard, member.
14. Recent Launching Practice of the Atlantic Coast. By Assistant Naval Constructor R. H. M. Robinson, U. S. Navy, member.
15. Recent Launching Practice of the Pacific Coast. By Everett P. Lesley, Esq.

MARINE ENGINEERING DATA CARD. NOVEMBER, 1904.

NAME—Aki-Maru. NATIONALITY—Japanese. TYPE—Ocean passenger and freight steamship.

LAUNCHED—1903. BUILDER—Mitsu Bishi Dockyard and Engine Works. OWNER—Nippon Yusen Kaisha.

Length between perps	445 ft. 4 ins.	Stroke	48 ins.
Breadth, molded	49 " 6 "	Valves, piston on H. P.	slide on I. P. and L. P.
Depth, molded	30 " 5 "		
Load draft	25 " 0 "	I. H. P., on trial	5,398
Displacement	11,780 tons	Speed, " "	15.36 knots
Dead weight capacity	6,745 "	**Boilers:**	two single-end; two double-end
Tonnage, net	3,995	Length	10 ft. 0 ins.; 17 ft. 6 ins.
" gross	6,444	Diameter	13 " 9 "
Water ballast	1,797 tons	Pressure	200 lbs.
Coal, net, bunkers	514 "	Number of furnaces	18
" in reserve bunkers	966 "	G. S.	325 sq. ft.
Cubic capacity	370,000 cu. ft.	H. S.	9 975 "
Stores	11,700 " "	H. S. ÷ G. S.	30.7
Engines:	twin screw, triple	H. S. ÷ I. H. P.	1 85
Cylinder diams	20, 33 1-2, 56 ins.	I. H. P. ÷ G. S.	16.6

Proposals for Warships.

The Navy Department has issued two circulars describing the proposed 16,000-ton battleship *New Hampshire,* and the two 14,500-ton armored cruisers *North Carolina* and *Montana,* which were authorized by the last congress. Plans and specifications will be furnished of the prospective boats on applying to the Department, and bids will be opened by the Department at noon, December 15, 1904. The ships are to be practically duplicates of the latest vessels of those classes now under construction, viz.: the battleship *Connecticut* and the armored cruiser *Tennessee.* The price of each ship, exclusive of armor and armament, is limited to $4,400,000. The maximum time allowed for completion will be 42 months, with a penalty of $300 a day for the first month delay in completion and $600 a day thereafter until completion.

The battleship must, on a four-hour trial, maintain an average speed of 18 knots. She will also be subjected to progressive speed trials and an endurance trial of 24 consecutive hours at two-thirds power. Her general dimensions are to be as follows:

Length on load water line, 450 feet.

Breadth, extreme, at load water line, 76 feet 10 inches.

Displacement on trial, not more than 16,000 tons.

Mean draft to bottom of keel at trial displacement not to exceed 24 feet 6 inches.

Total coal bunker capacity, about 2,350 tons.

Coal carried on trial, 900 tons.

Feed water on trial, 66 tons.

Ammunition, 405 tons.

Guns, mounts, magazine equipments, etc., 1,063 tons.

Armor, armor backing splinter bulkheads, etc., 3,935 tons.

Steam engineering, complete, 1,500 tons.

The armament is as follows: Main battery, four 12-inch breech loading rifles, eight 8-inch breech loading rifles, twelve 7-inch breech loading rifles, four submerged torpedo tubes. Secondary battery, twenty 3-inch, 14-pounder, rapid fire guns; twelve 3-pounder, semi-automatic guns; four 1-pounder, semi-automatic guns; two 3-inch field pieces; two machine guns, .30 caliber; two automatic guns, .30 caliber.

It will be noted that the above dimensions and armament are identical with the ships of the *Connecticut's* class; the armor is also much the same. The 12-inch guns to be mounted in two turrets, one forward and one aft, the 8-inch guns in four turrets, two on each beam at the ends of the superstructure, and the 7-inch guns on pedestal mounts on the gun deck behind 7-inch armor and separated by splinter bulkheads.

The hull is to be protected on the water line by a complete belt of armor 9 feet 3 inches wide, with a uniform thickness of 9 inches for about 285 feet amidships, gradually decreasing to 4 inches at the stem and stern. The side and end casemate armor is to be 7 inches thick. The 12-inch turrets are to have a front plate of 12 inches and the remaineder 8 inches thick, the barbettes are 11 inches. The 8-inch turret front plate will be 6 1-2 inches and the rear plate 6 inches, and the barbettes with 6 inches front and 4 inches in the rear. The conning tower will be 9 inches thick with 6-inch armor tube extending to protective deck. The

protective deck extends from stem to stern 2 1-2 inches on the slopes and from 1 to 2 inches on the flat.

The general dimensions of the armored cruisers are to be as follows:

Length on load water line, 502 feet.

Breadth, extreme, at load water line, 72 feet 10 1-2 ins.

Displacement on trial, not more than 14,500 tons.

Mean draft to bottom of keel at trial displacement not to exceed 25 feet.

Total coal bunker capacity, about 2,000 tons.

Coal carried on trial, 900 tons.

Feed water on trial, 66 tons.

Guns, mounts, magazine equipment, etc., 626 tons.

Ammunition, 2-3 cruising supply, 338 tons.

Steam engineering, complete, with water in boilers, 2,060 tons.

Total protection, 2,541 tons.

The armament consists of the following guns: Main battery, four 10-inch breech loading rifles; sixteen 6-inch breech loading rifles; twenty-two 3-inch rapid fire guns, four submerged torpedo tubes. Secondary battery, twelve 3-pounder semi-automatic rapid fire guns; four 1-pounder semi-automatic guns; two .30 caliber machine guns; two .30 caliber automatic guns; two 3-inch field guns.

These ships are to make on a four-hour trial an average speed of 22 knots and are also to be subject to progressive speed and endurance trials.

Heavy penalties are laid upon the contractors if the vessels fall below contract speed.

Launch of Battleship Nebraska.

An unusual incident connected with the launch of a ship took place when the battleship *Nebraska*, built at Moran Bros. Company, Seattle, Wash., unexpectedly slid down the ways before the appointed hour. The time set for the launch was 2:13 o'clock, October 7. Most of the wedges had been driven and the shores removed at 2 o'clock; two minutes later there was a splintering of the wooden trigger which held the cradle, and the vessel gradually gathered headway and slid down the ways. Fortunately there was not an accident of any kind to mar the occasion; the sponsor of the ship showed presence of mind to break the christening bottle of champagne upon the bows before the ship got away. As the ship began to move, files of sailors and sodiers on either side of the ways were brought to present arms, and thus stood until the vessel gracefully floated on the water of Puget sound.

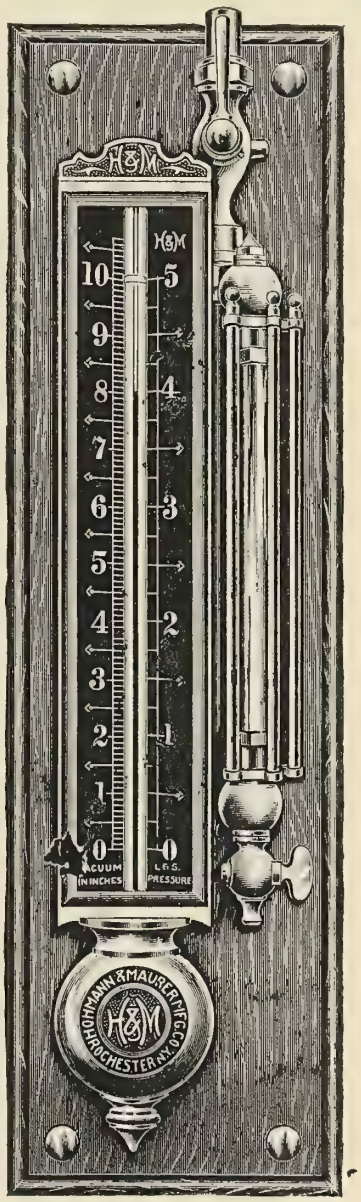
The *Nebraska* is of the *Georgia* class, and also a sister ship to the *Virginia*, described in Marine Engineering of June, 1904, and to the *New Jersey* and *Rhode Island*.

New Supervising Inspector.—The president has appointed Ira Harris to succeed R. S. Rodie as supervising inspector of the second district of the steamboat inspection service. Mr. Harris is a graduate of the Naval Academy and resigned as lieutenant commander after fifteen years to enter private business. At the outbreak of the Spanish war Mr. Harris again entered the navy and at the close of the war was appointed supervising engineer inspector of the army transport service, and after that was appointed to a post in the emigration service.

ENGINEERING SPECIALTIES.

Mercury Column Gauges.

As a result of the failure of dial thermometers to give satisfactory results on shipboard, the navy department has ordered the builders of war vessels to substitute mercurial thermometers of the Hohman & Maurer type. These makers have also recently perfected a device for determining the absolute pressure

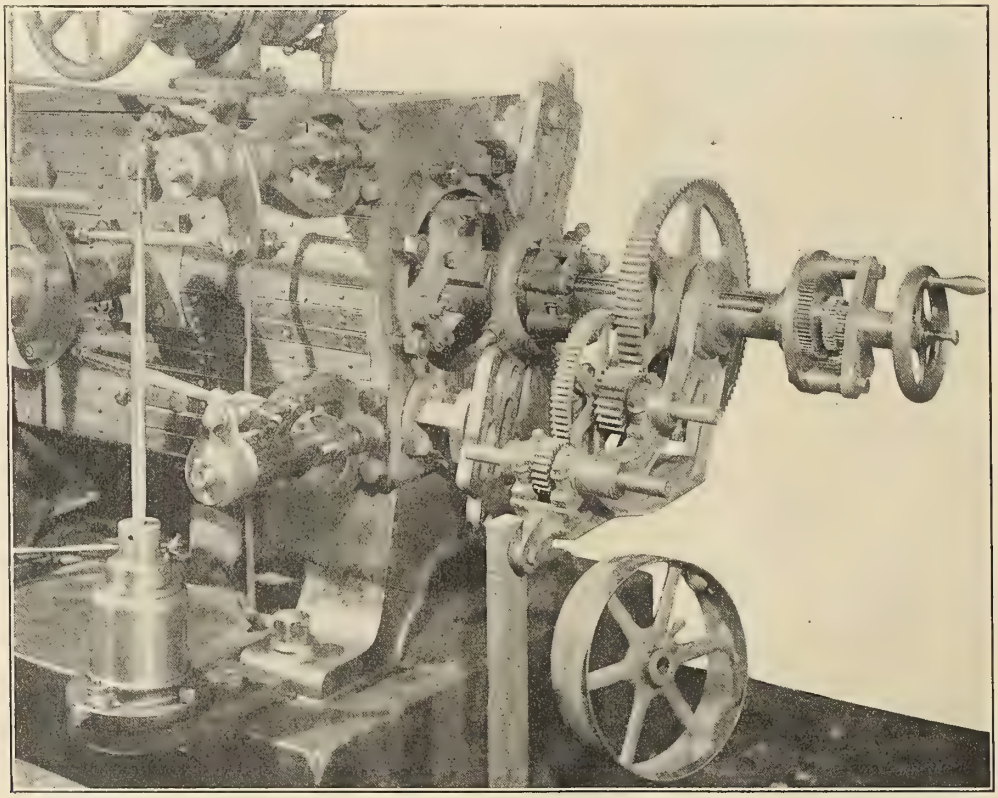


MERCURY GAUGE FOR THE ABSOLUTE PRESSURE IN A VACUUM.

of air remaining in a vacuum apparatus, such as a condenser, which indicates actual pressure above the actual vacuum. It is, therefore, read without reference to barometric reading or change of level in cistern.

In the illustration, the gauge glass at the right is a part of the condenser, which is not shown, and guards against possible errors due to water accumulating on the surface of the mercury. This is safely housed in

a wide cylinder behind the scale case, and cannot spill in transportation or handling, nor oxidize in a glass tube, since it does not come in contact with the air. Altogether, it is a most compact instrument mounted on a hard wood panel. The scale case is of bronze, highly polished and has an opening of 12 inches with the scale placed in the open V, a heavy plate glass is held with a metal frame. The scale is double and reads in vacuum in inches of water on one side and pounds per square inch on the other side.



PORTABLE BORING BAR, SUITABLE FOR CYLINDER OR STERN TUBE USE.

Portable Boring Bar.

The boring bar here illustrated is designed especially for use in places difficult of access, such as propeller shaft bearings. These bars are made from 2 1-2 up to 12 inches diameter, of stiff grade crucible steel, and are driven by a train of gears so arranged that the larger or master wheel can be quickly detached, thus allowing it to be put in places cramped for space, and makes it lighter to handle. The gear can be placed between frames and the bar run through. The cutter head holding the tools, which are of size suitable for the work, is moved along the bar by a steel screw having a strong well-designed thrust bearing. The rate of feed per revolution is regulated by trains of gearing in a casing and with a slip pin arrangement whereby any train of gears can be used to give light or heavy feed, as the material requires. The same bars are used and adapted for attaching to cylinders or other class of work. When supplied for boring stern post bearings the makers furnish an extra bearing, and sometimes the cutter heads are made in two pieces, which are fitted and bolted together. This latter arrangement is for use when boring through a bulkhead or other obstruction which prevents moving the machine along. Thus it is not necessary to shift the bar as set. The equipment for general shipyard purposes includes an extra long bar for other than cylinder work; all other parts are interchangeable. The manufacturers, H. B. Underwood & Company, 1025 Hamilton street, Philadelphia, Pa., have had many years' experience in designing tools for this service, and the result is that with their bar it is claimed that work can be done more rapidly than with other tools. A number of these boring outfits and other special tools have been shipped to foreign customers, as well as the United States navy yards and many shipbuilding companies.

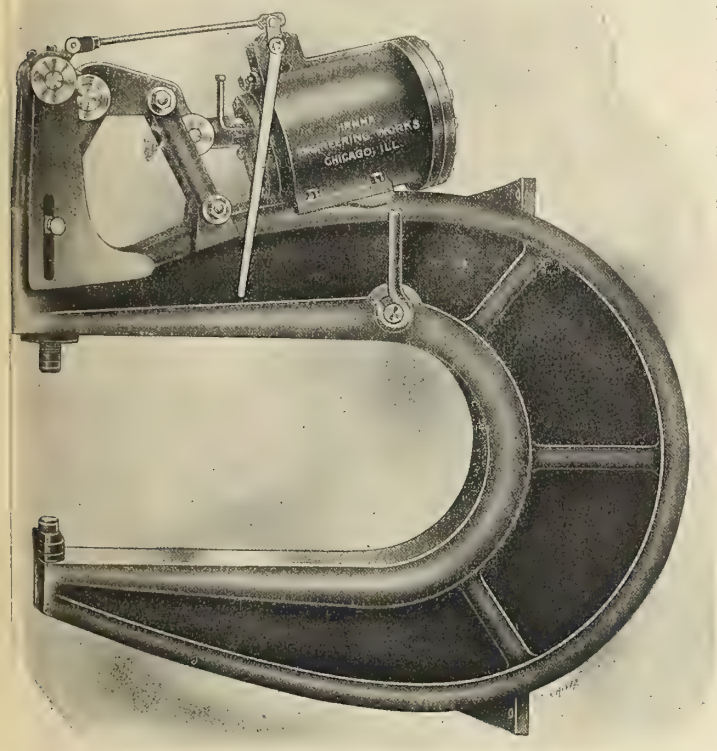
Pneumatic Compression Yoke Riveter.

In order to appreciate the characteristics of the Hanna compression yoke riveter here illustrated, it is necessary to have in mind the four general classes of compression riveting machines which are at present on the market.

The hydraulic machine, in which the riveting die is driven forward by and directly connected to a ram or piston, the operating fluid is under a high pressure of from 1,500 to 1,000 pounds per square inch. While this machine possesses the great advantage that the rivet is under maximum pressure for the full stroke,

the disadvantage and expense of maintaining the hydraulic packing and piping connections, as well as the line of high pressure piping, greatly restricts its use.

In the hydraulic-pneumatic machine, the riveting die is directly connected to an hydraulic plunger, which is operated by both a high and low pressure, a high pressure being obtained by the machine through an intensifying arrangement acted upon by pneumatic pressure. In this machine the same trouble is experienced with hydraulic packing, but the service pipe is not under the great pressure: it also possesses the advantages of the plain hydraulic machine.



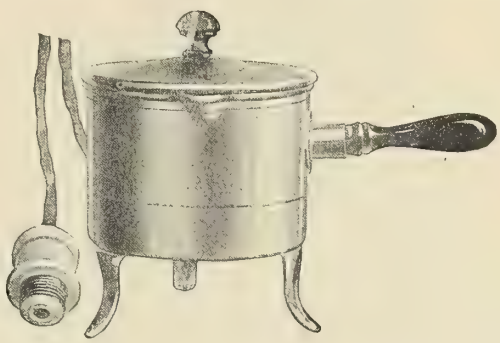
PNEUMATIC COMPRESSION YOKE RIVETER.

In the pneumatic machine the riveting die is attached to one end of the crank lever and the pneumatic piston to the other. This is satisfactory for ordinary structural work where but 50 tons pressure is necessary.

The fourth type is the pneumatic toggle joint machine, where the riveting die is attached to the end of one member of the toggle joint; the other member is joined to the main frame, and the piston rod of the pneumatic piston is attached to the center joint of the toggle. This arrangement gives a most desirable movement to the die, in that the relative movement of the die to the piston is greatest at the first of the stroke and least at the end of the stroke when the two are moving almost at right angles, but it is defective in that there is but one point at which the desired pressure is reached and this point is so near the end of the stroke where the leverage is changing so rapidly, that if the desired pressure is reached and the toggles are 1-2 inch from a straight line the expansion of the air in the cylinder will carry the toggles forward to the stop; thus if the rivets are not of exactly uniform length the die will require separate adjustment for each rivet.

The Hanna pneumatic compression yoke riveter, manufactured by the Hanna Engineering Works, 82 Elston avenue, Chicago, Ill., consists of a combination of toggles and levels to give the large opening of the toggle joint movement, with its gradually increasing pressure up to the desired maximum pressure, and then a simple lever movement throughout a considerable space under uniform maximum pressure. The space over which the uniform maximum pressure is available assures that the given pressure is applied to the rivet even if such rivets are not of uniform length, and the machine once adjusted for a certain length of rivet and thickness of plate requires no further adjustment.

These machines are built in several sizes. That here illustrated has a 29-inch reach, a 24-inch gape, and is provided with pneumatic cut-off. It will drive structural rivets up to 1 1-4 inches 42 inches from the edge of a girder with a cover plate 21 inches wide and is of 75 tons capacity. It may be operated by either air or steam.



SMALL, CONVENIENT ELECTRIC HEATER.

The Simplex Heater.

How often a little boiling water is wanted every day, and almost everywhere, has been appreciated by the Simplex Electric Heating Company, Cambridgeport, Mass., which has placed on the market a very convenient article that seems to meet the demand in the office, the hotel, on board ship, or wherever a lighting circuit is available. As shown in the illustration it is in the form of a cup with a plug and cord.

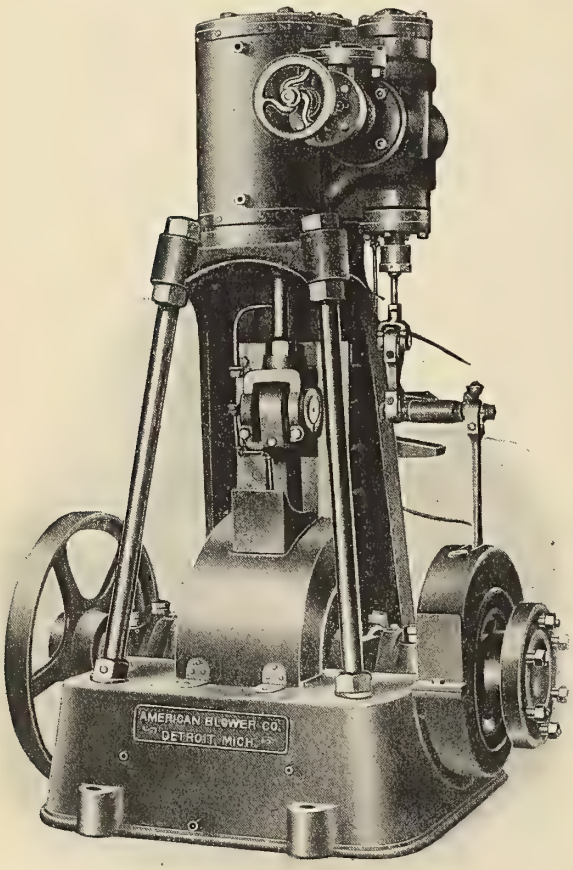
The illustration does not convey an adequate idea of the value and convenience of this device. A special feature is that it is so quick to boil that many a cup of tea will find its way to the busy office man who could not spare the time for it if compelled to bother with sooty gas and slower methods. It will boil a cup of water in three minutes, or a full pint in six, from the time of turning on the current.

For shaving, for some warm water to wash one's hands, or for any sudden demand, it is just what is required. Being bright, clean, and thoroughly sanitary, it can be used directly in a sick room.

It is ideal, for with all the above advantages its high efficiency makes the cost of operating slight, because with current at one-cent per lamp hour a pint of water can be boiled for less than 1-3 of a cent. Certainly nothing more can be desired.

Vertical High Speed Engine.

The American Blower Company, Detroit, Mich., has brought out a new line of vertical single cylinder engines of the marine type to meet the requirements where continuous operation is absolutely necessary. The engine here illustrated is identified as Type B, direct connected. It is mounted on a solid casting of box form, dished to receive the drippings and with suitable drain. The main bearings and brasses have ample surface and are lined with best quality of babbitt. The engine is



NEW HIGH-SPEED ENGINE FOR DIRECT-CONNECTED SERVICE.

mounted on a frame with cast iron back column and steel rods at front. The crosshead guides are fastened to the back column and are provided with screw adjustments. The cylinder and steam chest are cast in one piece and bolted to the top frame. The valve is of the double ported balanced type, and the piston is hollow, provided with snap packing rings. The crank shaft is a solid steel forging, with counterweight to reduce vibration; the eccentric rod and connecting rod are also forged steel, the latter with forked ends provided with brasses and suitable adjustment to take up wear. There is a slipper crosshead with wearing surfaces babbitted.

Lubrication to the main journals is supplied by ring oilers and that to the rest of the engine is fitted to give perfect and continuous lubrication. The engine as a whole is highly finished, all exposed metal parts being polished and carefully dressed down, filled and painted. In the automatic type the Rites-Carpenter fly wheel governor is furnished.

Automatic Center Punch.

An automatic center punch entirely new in design, containing features that make it much more convenient and accurate for laying out work to be machined or drilled than the ordinary center punch and hammer, has recently been placed on the market by the Brown & Sharpe Manufacturing Company, Providence, R. I.

In designing this tool every care has been taken to combine lightness and simplicity with durability. The various parts are proportioned to withstand the most severe usage to which a tool of this character should be subjected. All parts are of steel proportioned and adjusted to avoid libability of getting out of order. The parts most subject to wear are carefully hardened

AN AUTOMATIC CENTER PUNCH.

The tool is self-contained, the striking mechanism being enclosed in the knurled handle, which is of such a size and form as to be conveniently held in the hand. It is about 5 1-4 inches long and 5-8 inch diameter.

When following a line or establishing a point by the intersection of lines, one hand can be free to guide the point or hold the magnifying glass, and, after the point is located, it is not apt to slip and lose the setting, as just a downward pressure of the handle releases the striking block and makes the impression. Another advantage appreciated by mechanics is that the punch marks are all of uniform depth, and, therefore, more easily and accurately followed than when of varying depths.

QUERIES AND ANSWERS.

All reasonable questions concerning marine engineering received from and signed by subscribers will be answered by the editor in this column. All communications must bear the name and address of the writer.

Q. 252.—Will you please give rule for setting piston valves of a marine compound engine with Joy valve gear.

Also tell me how to find the dead centers of a marine compound engine. READER.

A.—To fully describe the method of setting the Joy valve gear would take more space than we can use in these columns, and therefore we would advise you to refer to some of the many books on this subject, preferably Durand's *Practical Marine Engineering*. To set a Joy gear embodies no more features than that of the ordinary gear, as the valve gear has already been designed and built, and the lengths of the different connecting arms established. The principal difficulty is to balance up each end, which can be done by lengthening or shortening of valve stem. In the piston valve the engine must be slowly turned over and the location of the valve must be determined by sighting through peep holes in the shell of the valve chest. It is of course impossible to get all the features of both ends such as admission, cut-off, exhaust, opening and closing the same. The valve should be so adjusted that each point on top and bottom balances fairly closely without distorting the other points. The setting of the valve may be most advantageously done by the use of indicator cards. We wish it were possible to fully answer your question, but to do so would open up a very broad topic.

There are several ways of marking the dead centers on an engine: one by sighting with the eye along a bob weight swung from the center of a crosshead pin along the connecting rod. Another good method for permanent use is by marking on the crosshead slide and guide and on the main shaft adjacent to a journal as follows:

Turn the engine over until the crank is almost on a center, say to such a point that the crosshead has but one inch more to slide to the end of the stroke. Draw a horizontal line across the crosshead and the guide, also mark the shaft at a convenient place adjoining a journal, and mark the journal opposite the point. Now, slowly turn the engine over the center until the marks on crosshead and guide again come opposite each other; mark on the journal the point opposite which the shaft mark now is. Measure off the distance between the two marks on the journal, divide in two and mark this half distance. Now by bringing the mark on the shaft opposite this new journal point the engine will be brought on a dead center.

Q. 253.—Kindly advise through your MARINE ENGINEERING, of the next issue, the limitable size of a steam pleasure craft, for a person to own and guide through the waters of New York—the person not wishing to go through a nautical examination.

A. G.

A.—The United States steamboat inspectors issue a special engineer's license for pleasure steam vessels up to 10 tons. For larger vessels a regular license is required. Full information may be obtained by applying to the U. S. Steamboat Inspection Service, Washington, D. C., or to your nearest local inspector.

If "G. W. P." of Marysville, Cal., will write to us, we will answer his question.

Q. 255.—Will you kindly let me know if I am correct in the way I have worked out the following, and, if not, point out my errors?

As I understand it, the moment of inertia of a rectangle is $\frac{L\,B^3}{12}$, and if a vessel had a rectangular water plane at the load line, then $\frac{L\,B^3}{12}$ divided by the volume of displacement in cubic feet would give the distance in feet and fractions of a foot from the center of buoyancy to the transverse metacenter.

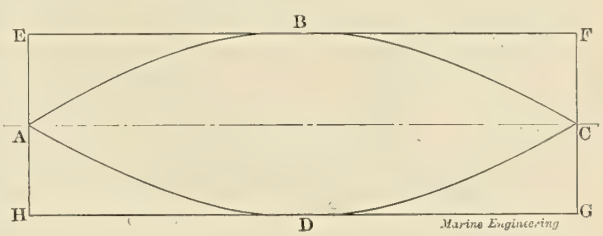
Now, if you know positively the exact full area of your load water plane, can you not express yourself as follows:

$\frac{A\,B^2}{12}$ = moment of inertia of L. W. plane, where A = the full area, and then by dividing this answer by the cubic foot of displacement obtain the height of the transverse metacenter above the C. B.

I have a lunch whose total load water plane area is 52.94 square feet, and whose greatest water line beam is 3.62 feet. Therefore, can I say $\frac{L\,B^3}{12} = \frac{A\,B^2}{12} = \frac{52.94 \times 3.62^2}{12}$, and divide my answer by 33, which is the displacement in cubic feet, and obtain the desired distance between C. B. and metacenter? J. R. H.

A.—You are incorrect in the assumption that you can use for your actual water plane a formula which is correct only for a rectangle.

It is perfectly true that $A \times B^2 \div 12$ will give the moment of inertia of a rectangle about an axis through the middle, and running at right angles to B. This would therefore be a correct formula for a scow or float with rectangular water plane. When you depart from the rectangle, however, and approach the typical form of the water plane area of a ship, such formulæ no longer applies. As to why it does not apply may be seen without going into the mathematical discussion by the following considerations:



The moment of inertia of an area about an axis may be defined as the sum of an indefinitely large number of small elements, each one of which is the product of its area by the square of its distance from the axis. Counting each element of the same area, therefore, it follows that the moment of inertia will depend on the total area and on the *location* of the elements as affecting the value of the square of the distance from the axis. Now, compare the area A, B, C, D, which represents your water plane, with E, F, G, H, which represents a rectangle, which would just surround it. Then your proposition is to take the area A, B, C, D, and multiply it by 1-12 the square of F, G, and call the result the moment of inertia of A, B, C, D. Now, recurring to the definition of the moment of inertia, it may be seen that it really represents the product of the total area by an average or mean square of the distances of its elements from the axis. Now, it is this mean square which in the case of the rectangle is represented by 1-12 the square of the breadth. But it may be seen that the mean square for the rectangle will be greater than that for the water plane area by reason of the influence of the corner parts

A E B, B F C, etc. These lying as they do would make the mean square for the rectangle greater than that for the water plane area, and therefore in using $P^2 \div 12$ for the mean square of A, B, C, D, a value too large would be employed, and a value for the moment of inertia would result in excess of the true value.

Knowing your water plane area and the dimensions, you may, however, find the moment of inertia quite closely by the following approximate formula:

$$I = \frac{B^2 A}{12}\left(1.2\,\frac{A}{BL} - .1\right)$$

Where A = area of water plane,
B = breadth " "
L = length " "

In your case you do not state the length, but if for illustration it is taken at 20 feet then we shall have as follows:

$$\frac{A}{BL} = \frac{52.94}{3.62 \times 20} = .731.$$

$$1.2 \times .731 - .1 = .777.$$

$$I = \frac{3.62^2 \times 52.94 \times .777}{12} = 45.25.$$

and $45.25 \div 33 = 1.37$ feet = distance of metacenter above center of buoyancy.

Q. 258.—Please answer in your magazine why boilers on western river steamboats (two-flue boilers) are made of so many small sheets, while Scotch boilers are made of one or two large sheets, for the same pressure. C. A. G.

A.—As far as we are aware the reason that the boilers on western river steamboats are made of smaller sized plates is that said plates are easier to handle in the shop than plates of greater thickness and size. The western river type of boiler is a development to suit the conditions. It would not do for steamship service, as it takes up too much room. As its diameter is small the plates are correspondingly lighter than those of Scotch boilers of the same type.

Q. 259.—Please inform me how to equalize the horse power of a triple-expansion engine, assuming that the intermediate was way above the H. P. and L. P. Also, how could I determine the consumption of water by a triple-expansion engine per hour approximately? Oiler.

As you have not stated the size of engine, our answer must be in general remarks. In the first place the ratio of the size of cylinders may be at fault, for in a multiple expansion engine the areas of the cylinders must bear certain relations to each other in order to properly distribute the power among the cylinders. This ratio depends upon the boiler pressure and is about as follows:

Boiler Press	120	140	160
Area L. P. / Area H. P.	5.4	6.2	7.0
Area M. P. / Area H. P.	2.11	2.25	2.4

In your engine we assume the cylinders follow closely these ratios, otherwise they are out of proportion and it will be more difficult to equalize the power and a change may be necessary in the valve. With correctly proportioned cylinders and valves the adjustment may usually be made by linking in or out. You say nothing about the valves, so we also assume these to be of correct design.

Now, to place more power in the high pressure cylinder, link out the intermediate to give the latest cutoff. This will tend to reduce the receiver pressure, which it is to be remembered is the back pressure of the high pressure cylinder, and the admission of the intermediate. Thus there is a wider range of effective pressures in the high and a narrower range in the intermediate, the resulting effect being an increase of power in the former and a decrease of power in the latter cylinder. This effect may be readily seen on a set of indicator cards.

Similarly to place more power in the low, link *in* on that valve. The result may not be so noticeable, but generally it will have the desired effect. If this simple procedure does not distribute the power correctly, an examination of the valves, amount of lead, steam and exhaust lap, travel, etc., will doubtless reveal the point of trouble.

A rough approximation of the water rate of an engine, single or multiple expansion, is determined by measuring on the indicator card the volume, including clearance, of any one of the cylinders, preferably the high pressure cylinder *up to the point of* cut-off, which is the volume of steam used each stroke. This point is marked *a* on the accompanying indicator card, which is that taken from the head end of the high pressure cylinder on the trial trip of the revenue cutter *Mohawk,* described in the July issue of Marine Engineering. The volume of steam to this point is indicated by the shaded rectangle *a, a', a'', a'''*, and the pressure at *a* is measured vertically from the atmospheric line.

On the return stroke there is always left a certain amount of steam in the cylinder and clearance, as shown by the compression line. This amount must be deducted to obtain the net weight of steam supplied to the engine. The point *b* on the card is taken as the point at the end of compression, and the area *b, b', a''* and *b''* represents the volume of steam left in the cylinder at a pressure measured by the line *b', b*. For simplicity's sake we will assume that the steam is saturated at points *a* and *b*. Following are some of the dimensions and data of the engine and trial.

Cylinders 25, 37 1-2, 56 1-4 inches by 30 inches
Revolutions per minute.....154
Indicated horse power.....2,604
From the card the following quantities are found:
Clearance, per cent. of stroke assumed.....14.7
Point of cut-off, per cent. of stroke.....80.3
Point of cut-off, per cent. of stroke from clearance line 95.0
Cut-off, pressure at *a*, pounds.....110
Compression, per cent. of stroke.....16
Compression, pressure at *b*, pounds.....107.2
Area of cylinder, square inches.....490.9
From the above we calculate the following:

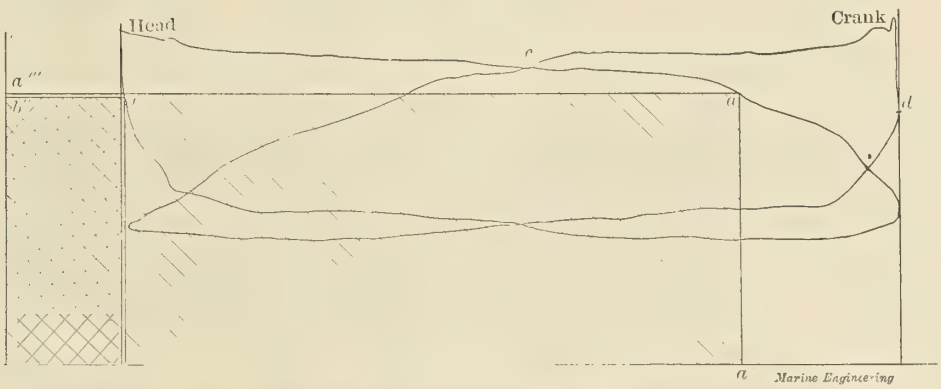
$$\frac{490.9 \times 30'' \times .95}{1728} = 8.10 \text{ cubic feet of steam per stroke.}$$

$$\frac{490.9 \times 30 \times .16}{1728} = .136 \text{ cubic feet of steam left in cylinder.}$$

From the tables of saturated steam it is found that at the cut-off and compression pressures, one cubic foot of saturated steam weighs .2833 pounds and .2769 pounds respectively. Multiplying the cubic feet by the respective weights per cubic foot, we have 2.290 pounds and .387 pounds respectively, and deducting the latter from the former the net amount of steam used per stroke is 1.903 pounds.

draft is used, the consumption being usually higher in the latter case.

The card factor is less in an early cut-off than with the late cut-off. This factor is used to account for clearance, compression, radiation, condensation, etc., between the theoretical condition of adiabatic expression and the practical results. Now these disturbing elements are practically the same whether the engine is running full or partial power; therefore, their ratio to the power developed is larger when running at partial power.



CALCULATING STEAM CONSUMPTION FROM INDICATOR CARD: ATMOSPHERIC LINE $a'a''$, CLEARANCE LINE $a''a'''$

A similar operation should be followed for determining the steam in the crank end of cylinder, but for simplicity's sake we will assume it to be as in the head end as above. Therefore, the number of pounds per hour per I. H. P. is

$$\frac{1.903 \text{ lbs.} \times 154 \times 2 \text{ strokes} \times 60 \text{ min.}}{2604 \text{ I. H. P.}} = 13.5 \text{ lbs.}$$

This is probably too little, as we have not allowed for moisture in the steam. It suffices, however to illustrate the method which, at the best, is approximate. The only accurate method is to weigh the condensed steam.

Q. 261.—Kindly answer in your Q. & A. column, in November issue if convenient, the following questions:

1. What would be a fair average of consumption of steam in pounds per I. H. P. per hour of a set of triple-expansion engines, the ratio of cylinders being 1:2.28:6.25; boiler pressure being 150 pounds?

2. What would be a fair average consumption of coal per I. H. P. per hour in same set of engines, the cut-off in H. P. being about 3-4 stroke, the ratio of expansion about 9, and coal containing 10 per cent. of ash?

3. In an early cut-off would the card factor be higher than in a late cut-off? Kindly compare cut-off of 1-2 and 3-4 stroke for example. W. G.

A.—In some recorded tests of stationary triple expansion engines the water rate has been as low as 11 pounds per hour; but for usual good practice, 15 pounds may be considered an average figure. The coal consumed per I. H. P. depends upon the efficiency of the boilers. In the very best practice in marine work, where all the refinements and requirements known to engineering are used, a record of one pound of coal per I. H. P. has been made. For large size transatlantic ships a rate of 1.3 to 1.6 is the usual figure. The amount of coal burned will also depend upon the quality—that is, the number of heat units per pound of coal; also the method of firing and whether natural draft or forced

PERSONAL.

Joseph A. Barraja-Krauenfelder, formerly with the Fore River Shipbuilding Company, has accepted a position with the Holland Torpedo Boat Company, New Suffolk, L. I.

SELECTED MARINE PATENTS.

767,490. DIRIGIBLE TORPEDO. DAVID W. McCAUGHEY, CHICAGO, ILL. Twelve claims.

767,491. DIRIGIBLE TORPEDO. DAVID W. McCAUGHEY, CHICAGO, ILL. Three claims.

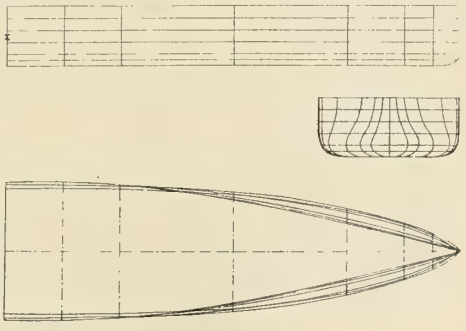
767,492. DIRIGIBLE TORPEDO. DAVID W. McCAUGHEY, CHICAGO, ILL. Twelve claims.

767,835. SUBMARINE SALVAGE VESSEL. JEAN M. RAOUL, TUNIS, AFRICA. Seven claims.

768,085. SAFETY KEEL FOR VESSELS. FRITZ O. STROMBORG, CLEVELAND, OHIO.

Claim.—1. A vessel and a safety keel on the bottom thereof consisting of two independent sections one above the other, a shaft on which said sections are mounted and mechanism for operating each section separately. One claim.

768,269. CONSTRUCTION OF SHIPS. HELEN CLARK, WASHINGTON, D. C.



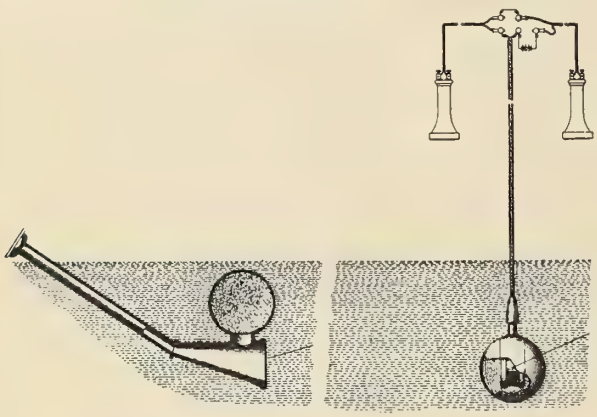
Claim.—1. A ship or vessel in which the angle of obliquity formed by the load water line, at the stem or cut water, with the longitudinal vertical middle plane of the vessel is smaller or more sharply pointed than the angle of obliquity formed by all the other water lines with the said longitudinal middle plane at points below the load water line. One claim.

768,567. SUBMARINE SIGNALING. ARTHUR J.

MUNDY, BOSTON, MASS., ASSIGNOR TO SUBMARINE SIGNAL COMPANY, WATERVILLE, ME.

Claim.—1. In an improved method of submarine signaling the transformation of the energy of the natural motion of the water into energy in the form of sound waves of a quality for submarine signaling, and the delivery of such sound waves to the water at a point below its surface. One claim.

768,572. SOUND TRANSMITTER AND RECEIVER. ARTHUR J. MUNDY, BOSTON, MASS.



Claim.—1. In a system of submarine telephony, a means for imparting to water at a point beneath its surface the vibrations of articulate speech, and a submerged electric transmitter and receiver adapted to receive said vibrations so imparted to the water and to electrically transmit them to a sound receiver. One claim.

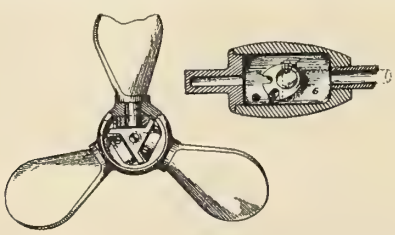
768,701. WAVE POWER APPARATUS. JOHN H. SMITH, LOS ANGELES, CAL. Fourteen claims.

769,100. SUBMARINE SIGNALING. JOSIAH B. MILLET, BOSTON, MASS.

Claim.—1. The method of communicating information as to the position or direction of a moving vessel to an observer removed from the vessel, consisting of the employment of the vessel itself, in connection with devices upon the vessel for producing sound vibrations or waves in the water surrounding the vessel, and the turning of the vessel for varying the degree of value of said sound waves or vibrations in a given direction. Three claims.

769,256. PROPELLER. HERRMAN ENGE, WEST BERKELEY, CAL.L

Claim.—A propeller comprising a hub, a series of propeller blades rotatably secured therein, a series of cranks located within the hub and connected to the shank of each blade, a pair of seats cut in each crank, a longitudinally movable rod working through



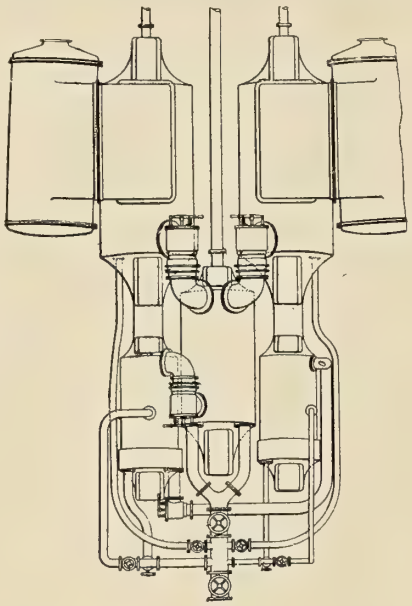
the hub, and a series of projecting studs carried by said rod, said studs engaging with the seats of the cranks so as to operate the said cranks to shift the blades during longitudinal movement of the rod. One claim.

769,272. MARINE STEAM TURBINE. CHARLES A. PARSONS, NEWCASTLE-ON-TYNE, ENGLAND.

Claim.—1. A system of turbines for propelling vessels consisting of a main turbine set for propelling the vessel with high economy at fast speeds, and an additional turbine set adapted to be put in series with the main turbine set when the vessel is to be propelled with high economy at cruising and low speeds, and automatic means for preventing a back flow of steam from the main turbine set to the additional turbine set when the former set is propelling the vessel at fast speed.

3. A system of turbines for propelling vessels, consisting of a main turbine set for propelling the vessel with high economy at fast speeds and an additional turbine set adapted to be put in series with the main turbine set for propelling the vessel with high economy at cruising and slow speeds, the main set comprising a high-pressure and two low-pressure turbines of large capacity mounted upon separate propeller shafts, and the additional set comprising a high-pressure turbine and an intermediate-pressure turbine mounted upon extensions of the propeller shafts.

5. A system of turbines for propelling vessels, consisting of a main turbine set for propelling the vessel with high economy at fast speeds and an additional turbine set for propelling the vessel with high economy at cruising and slow speeds, the main set comprising a plurality of turbines of large capacity and the additional set comprising a plurality of turbines of relatively small capacity, piping putting the cruising turbines in series with the main turbines, non-return valves in this piping between the turbines of both sets, valve-controlled live-steam inlets to each turbine, and additional live-steam inlets to each turbine, and additional live-steam inlets situated at intermedite positions in the lengths of the turbines of the cruising set. Five claims.

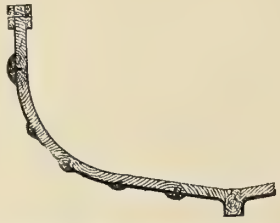


769,316. LIFE BOAT. ROBERT D. MAYO, GRAND RAPIDS, MICH. Three claims.

769,456. PROPELLING VESSELS. LUDWIG AUDRIETH, NEWARK, N. J.

Claim.—1. In a hydraulic propeller, the combination with the hull of a vessel having a duct extending longitudinally through the same, of an intermediate ejector nozzle in said duct, a chest in communication with said ejector nozzle, a receiver connected to said chest, a pump connected to said receiver, and tubes connected with openings in the hull and with said pump for supplying a continuous stream of water to said ejector nozzle. Four claims.

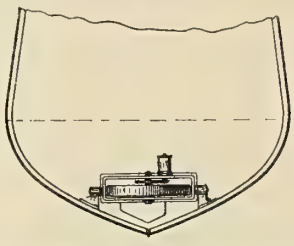
769,502. MARINE HULL. THOMAS H. SMITH, STURGEON BAY, WIS.



Claim.—1. A marine hull, comprising ribs, beads extending fore and aft along the other sides thereof, and metallic sheathing sections, one edge of each section lying under the bead adjacent thereto, and the other edge portions of the sheathing sections extending over the adjacent beads. Five claims.

769,621. SCREW PROPELLER. CAREY A. MANKER, PEARL, ILL. Five claims.

769,693. DEVICE FOR STEADYING SHIPS. THOMAS C. FORBES, MINNEAPOLIS, MINN.



Claim.—1. The combination with a vessel, of a fly-wheel support mounted to oscillate on an axis extending transversely of the axis of the vessel, a fly-wheel journaled in said oscillating support with its axis extending transversely of the axis of said support and of the longitudinal axis of the vessel, whereby the said fly-wheel is set to rotate in a plane extending in the general direction of the longitudinal axis of the vessel, and means for rotating said fly wheel. Six claims

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Marine Engineering

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TRIAL TRIP OF THE NEW PROTECTED CRUISER COLORADO.

A new speed record of the United States Navy for vessels carrying side armor, was recently made by the *Colorado* when she covered the Cape Ann course of 88 miles at an average speed of 22.24 knots. Previous to this the record has been held by the *Brooklyn,* which made 21.91 knots. The *Colorado* is one of six similar vessels now nearing completion, the others being the *Maryland, Pennsylvania, South Dakota, California,* and *West Virginia.* All these ships are contracted for 22 knots, and the *West Virginia* on November 2 covered the Cape Ann course at 22.14 knots. The principal dimensions of hull and machinery of this class of vessels have been previously given in MARINE ENGINEERING,* and suffice it to add that these ships may be considered the most efficient and powerful armored cruisers afloat, both in point of armor and armament.

There is a complete water line belt or armor 7 feet 6 inches deep, which has a maximum thickness of 6 inches, diminishing to 3 1-2 inches at the ends. Above this is side armor 5 inches thick carried up to the main deck, with 4-inch thwartship armor at the ends. The protective deck varies in thickness from 1 1-2 inches on flats to 4 inches on the slopes. The battery consists of four 8-inch rapid-fire guns, mounted in two 6-inch barbettes, one forward and one aft, and fourteen 6-inch rapid-fire guns placed on the gun deck behind the side armor and separated from each other by 2 1-2-inch splinter bulkheads. The ammunition hoists are capable of conveniently supplying the guns with ample amount of powder and shell, and all hoists are driven by electricity.

The addition of these six fighting ships to our navy will be a very material one, as they are not only capable of steaming at high speed but of taking their position in battle line.

UNITED STATES PROTECTED CRUISER COLORADO, ENTERING DRY-DOCK, PREVIOUS TO TRIAL TRIP ON WHICH SHE MADE 22.24 KNOTS.
[Photograph Copyrighted, 1904, by Enrique Muller.]

*See MARINE ENGINEERING, page 317, (*California*); page 402 (*South Dakota*).

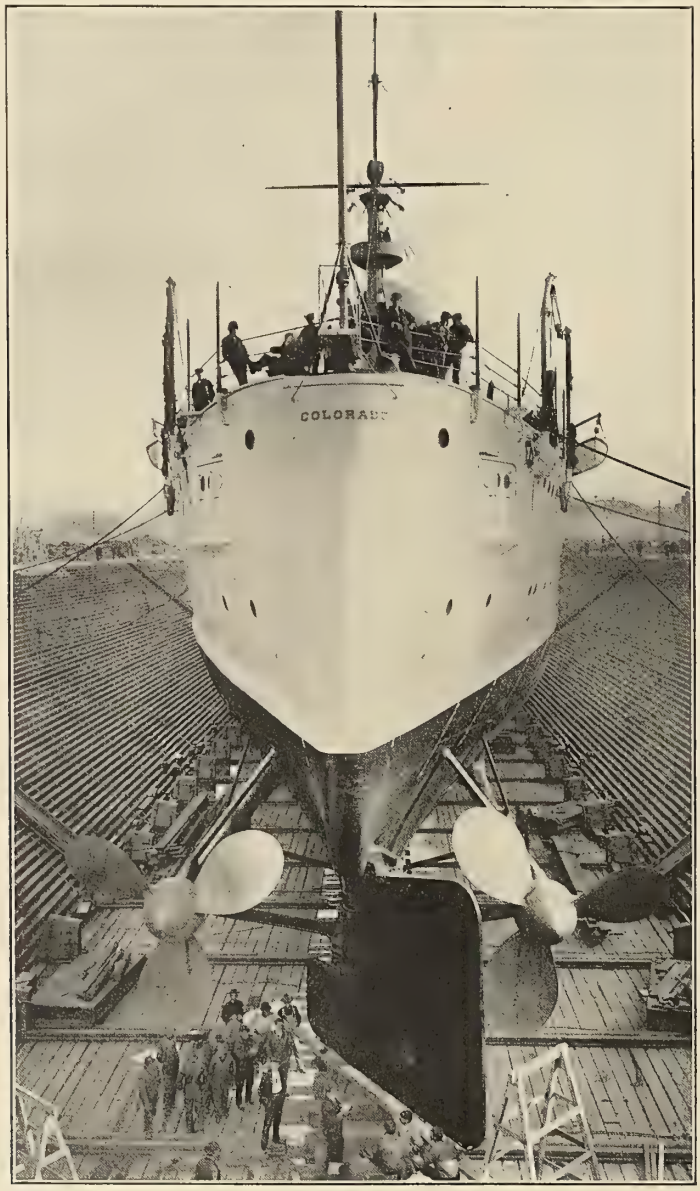
(Copyright, 1904, by Marine Engineering, Inc., New York.)

An Exciting Time Off Charleston in 1862.

BY F. C. RUSSELL.

Fire at sea is a fearful foe to combat, and when we add to this the possibilities of an explosion in a magazine stored with powder and shot, we have factors which are far reaching in their results, and may well be dreaded; such were the conditions on the gun boat *Huron,* December 22, 1862. The good effect of thorough discipline was very manifest at this time. The writer was then an engineer on the *Huron,* and for several weeks we had been having "fire drill," "calling to quarters," and giving the alarm, at most unexpected times, but the drill was tame in comparison to the real experience of fire. On this particular day we received signals to run down to the flag ship, the *Powhatan,* off Charleston bar. Our port boiler had been leaking for several days, requiring the constant assistance of the donkey pump. Between ten and eleven in the forenoon one of the tubes in the port boiler burst, throwing some fire into the fire room. The cry of "Fire!" was heard, all hands were called to quarters, and the fire alarm sounded. Nothing of the ship was then visible from the smoke pipe to the stern, because of smoke and steam.

Our captain, Lieutenant-Commander George A. Stevens, was immediately on the bridge, and the first order given inspired confidence. Never shall we forget the word which came thundering from that bridge, distinctly audible above the hissing of steam, and crackling of burning wood: "Silence! fore and aft!" and then we knew there was a cool head to direct affairs, and discipline came to the front. The engines were ordered stopped immediately. There was some duty for every one except the paymaster. In far less time than it takes to tell this story, a line of hose was run along the deck,



STERN VIEW OF THE CRUISER COLORADO IN NAVY YARD DRY-DOCK.

[Photograph Copyrighted, 1904, by Enrique Miller.]

and a stream of water directed down the fire room hatch way. Fire was hauled from the remaining furnace in the boiler, and one of the engineers, with a bunch of cotton waste over his face, crawled over one of the steam pipes and shut off the connection between the two boilers.

On deck matters were also progressing rapidly. Signals of distress were hoisted, all our boats were swung over the rail ready for lowering, a bag of hard tack and keg of water in each boat. All our guns were discharged, so in case we left the ship we should not be in danger from our own guns, and the loose shot and shell were placed ready to throw overboard. The only person who seemed at all over excited (I will not say afraid), was the paymaster, for the very apparent reason there was nothing for him to do. He rushed on deck and called to the master's mate in charge of the 24 pounders on our quarter, "Fire those howitzers!" The mate told him to keep quiet, he would fire those guns when he received orders. The impression received at that time has never left me, that the best nerve tonic in a time of danger is to be in the line of duty with a definite thing to do.

My position in connection with hose and pumps at fire quarters called me on deck at such times, and I was enabled to observe much more than I otherwise should had I been on watch below. We found the real damage to the ship was slight, a little wood work around one of the coal bunkers was all that was burned, and the whole affair was over in about twenty minutes. Our chief engineer, in assisting below, stepped into the hot water in the fire room, burning his heel, and was obliged to sit with his foot on a pillow for a week or ten days after. One of our first-class firemen, who was in back of the engine, rushed out between the engine and boiler, scalding his neck and arms. He was promptly treated by our surgeon, who tore a bed quilt apart, using the cotton to make some kind of a plaster. This fireman received such a shock that we could not get him to again touch a shovel on either of the furnaces, so on his recovery we put him in charge of the engineer's stores.

In answer to our signal of distress boats from other vessels in the fleet began to put off for us, and the first boat to come within hailing distance was the second cutter from the United States steamer *Stettin*. The officer in charge of the boat called to us, "*Huron* a-hoy! What's the matter on board?" By this time, however, the fire was all out and the answer went back from an excited officer of the deck, "We are all right!" The cutter then went back to the *Stettin*, and all they could learn on that ship for a long time about the matter on the *Huron* was that she was "all right."

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 78 sail and steam vessels of 14,024 gross tons built in the United States and officially numbered during the month of October, 1904. The largest steel steam vessel included in these figures is the *Elizabeth*, of 1,197 gross tons, built at Wilmington, Del., and the largest wooden vessel is the schooner *Jane Palmer*, of 3,138 gross tons, built in Boston, Mass.

ELECTRIC HAULAGE IN GERMANY.

BY CLARENCE B. SCHULTZ, DR. ENG.

The transportation of large masses of bulky merchandise and raw materials has always been a problem of keen interest to the parties concerned. The well-known fact that there is no cheaper way than to ship by water keeps the question of improving the natural water ways and connecting the different rivers systems by artificial canals continually before the authorities of all thriving and well governed countries.

A good example of modern rapid transit by water and one representing probably the farthest developed state of art at the present time is the Teltow canal, near Berlin, Germany.

The moving facts for building the canal, the preparations leading up to the system of traction best adapted for the purpose, the description of the machinery finally adopted, and a financial review of the different electric haulage systems will be treated here more fully.

The capital of the German empire, besides being a railroad center of the first order, has a rapidly increasing traffic by water. Ten million gross tons is expected to be this year's figure for the cargo that arrived and left. Of this amount about two million tons pass in transit. Berlin's figures for the last two years are:

	1902	1903
Number of barges in transit,	6 442	6 562
" " " arrived,	54 476	66 218
" " " sailed	53,315	65.243
Gross tons of cargo in transit	1.293,206	1.396,724
" " " arrived	5,361,964	6,793.138
" " " shipped	591,864	731,561

Berlin's numerous water ways and harbors becoming more and more crowded, the barges passing the city in transit were subjected to much delay. In order to relieve Berlin it was decided that a canal should be built to circumvent the city, connecting the river travel with the Spree to the south. By this new water way the transit traffic was to be diverted from the city canals and at the same time numerous suburbs obtained the very desirable communication by water. The county of Teltow, surrounding Berlin, was authorized by the government to take up the necessary funds and to build the canal through its territory. The route of the Teltow canal, which is nearly completed and partially in use at the present time, can be seen on Fig. 1.

A few further data may be welcome for general information. The length of the Teltow canal is about 23 miles, the cross section averages about 800 square feet, having a depth of 8 1-4 feet at low water. The flow of the water is very slow, being less than 14 inches per second at high water.

In order to increase the efficiency of the canal it was decided to adopt some electrical system of traction instead of the steam tug and the power of men and horses. This led to a thorough study of the existing methods of hauling canal boats. It was found that in Europe two systems of electrical haulage had been worked fairly successfully for some time.

1. The system of Professor Léon Gerard, by which

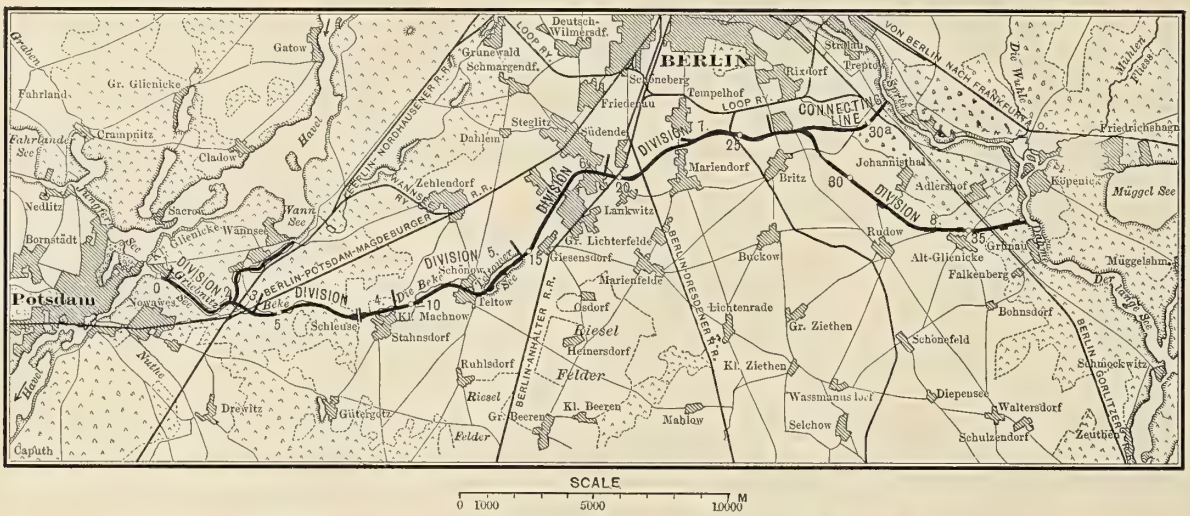


FIG. 1.—MAP SHOWING RECENTLY COMPLETED TELTOW CANAL, FOR DIVERTING TRAFFIC AROUND BERLIN.

the canal between Brussels and Charleroi in Belgium was operated until lately and which is still in use on the canal of Douai in northern France. See Figs. 2 and 3. The machine (cheval électrique) is practically an electric automobile using three-phase current and resting on four wide-rimmed wheels. It is fully described and a sketch shown in the September issue of Marine Engineering of 1902, so that further details can be omitted at this place. The difficulty, however, with this system, besides the expensive upkeep of the canal path, was that the man on the automobile had to watch the towed canal boat and at the same time steer his car, besides managing the brake, the rope, and the drum carrying it. Soon a Mr. Denèfle improved the former system by laying a regular railroad track and changing the automobile into a locomotive.

2. The second system referred to was the one designed by Mr. Koettgen, chief engineer of the well-known Siemens & Halske Company. It was practically tried and thoroughly tested during the year 1899 on the Finow canal, and is shown in Fig. 3. The electric trolley locomotive used has two axles, each carrying on the side next to the water a wide-rimmed wheel running directly on the canal path, while on the other side is provided a wheel running on a regular track. For this single track rails of about 13 1-2 pounds per foot have been used. The rope for pulling the barges was wound on a drum worked by hand power. The locomotive's weight was about 4,500 pounds, of which about 3,500 pounds are carried by the two wheels running on the track, which are also the drivers. The main item of interest is this unequal distribution of the weight in order to counterbalance the pull of the rope and to prevent the tilting of the machine. Extensive trials were carried on, among others with a barge of 250 tons displacement. The resistance was found to be 700 pounds at a speed of a little less than three statute miles per hour. The trials brought out the remarkable fact that the coefficient of utilization of this system of hauling, starting from the power at the wire, is about 60 per cent. The electric locomotive was built symmetrically so that it could be used both ways. It was thought sufficient to have the track on one side of the canal only and to exchange ropes when two locomotives met. The feasibility of this system was perfectly demonstrated by the trials of this first Koettgen locomotive.

The experience gained was incorporated in a new locomotive completed in 1900, which, however, was not subjected to any special trials, but sent to the Paris exhibition. As will be seen in Fig. 4, the wheels were simular to the first one. Instead of equipping the locomotive with one electric motor, as in the first, two were installed, one on each axle, bringing the weight of the machine up to 8,800 pounds and giving more adhesion to the rail, besides a better and more economical control. Another very important improvement was the adjustable sliding rope guide, by means of which the rope could be lifted over any obstacle between the locomotive and the barge if it was not excessively high. Before providing this guide it was frequently necessary to slip the rope altogether.

Besides the two systems of electric haulage actually tried there have been built or are prepared to be built three other systems having merit. The inventors are Rudolph, Vering and Feldmann.

Rudolph's system consists in a carriage of 2.75 tons weight running on an iron girder track and controlled from the towed barge; one motor for direct current is proposed.

Vering's electric locomotive (Fig. 5) uses three-phase current and has four inclined wheels, *AA*, on a single track driven by one motor, and like Koettgen's has a wide-rimmed plain wheel, *D*, on the water side of the track. To meet the pull of the rope the pressure on the four inclined wheels and thereby their adhesion can be increased. The locomotive weight is 2.5 tons.

Feldmann's locomotive (Fig. 6), weighing 4.8 tons, runs on light rails and has a roller resting against the third current-carrying rail from below preventing thereby any tilt of the machine. There are two motors; direct current is used.

Another unique system, originated by W. Fellenberg, may be mentioned here. The locomotive rests on two trucks having two axles each and being driven by 15 H. P. motors using three-phase current. All the eight wheels are drivers and therefore the total weight of the

machine (6 tons) is effective in pulling. The peculiarity of the system, however, consists in not using tow boats over the sections of the canal which cannot be provided with a track, but by letting the locomotive run over a slip on a pontoon, fastening it down and employing the machinery of the locomotive for driving the pontoon across the water, at the same time towing the freight barges. The propulsion of the pontoon can be by paddle-wheel, screw propeller, or by rope or chain. The latter is the one chosen by W. Fellenberg in the arrangement proposed for the Teltow canal.

There had also been made quite a number of trials with boats driven by trolley current transmission and storage batteries.

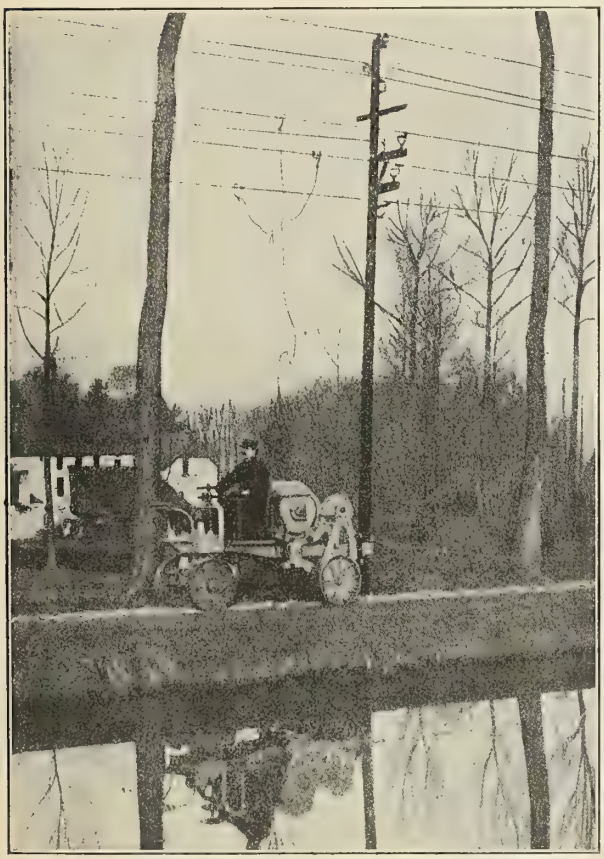


FIG. 2.—ELECTRIC TOWING AUTOMOBILE, LEON GERARD SYSTEM.

The Teltow canal authorities on close investigation found that no one of the existing systems of electric haulage was sufficiently developed and tried, to warrant its immediate introduction on the canal. In order to gather all possible up-to-date information it was therefore resolved during January, 1902, to advertise for a solution of the question on hand, holding out prizes ranging from $500 to $1,250. The conditions and data, technical as well as commercial, which had to be complied with, had been worked out in the most minute and thorough manner for the use of the engineering firms wishing to compete. The main points being as follows:

The canal is provided with paths of 6 1-2 feet width on both sides. There are seven bridges over which the locomotives can cross to the other side of the canal. The ascent of the path shall not exceed 1:20. The smallest radius of the canal line is 1,640 feet. There are three general classes of barges as per following table:

	Carrying Capacity Gross-tons.	Length Feet.	Beam Feet.	Draft Feet.
I.—Barge on system west of Berlin.	600	214	26¼	5¼
II.—Barge on system east of Berlin..	450	180	26¼	5¼
III.—Barge on Finow canal.....	170	132	15	4

The towing machine shall be able to tow one barge of the largest size, carrying its full load, at the rate of 2 1-2 statute miles per hour. The direct maximum pull at this speed is estimated to be about 3,300 pounds. The speed of the empty barges shall not exceed 3.12 statute miles, to prevent the damaging wash of the canal banks. Electricity is to be used as source of power, but the plant for generating and transmitting it was not to be the subject of the advertised proposition. The cost of 8,000-volt, three-phase current all along the canal can be assumed to be 2.87 cents per kilowatt hour. Other systems may be proposed. For the traffic calculations the average freight of the barges is to be taken at 65-70 per cent. of their full carrying capacity. Every fourth boat is to be assumed empty. This will sum up, for a yearly traffic of 1,500,000 gross tons of freight, to 1,025 barges of class I., 2,566 of class II., and 6,668 of class III., according to the usual percentage derived from the Berlin traffic. Besides there were given data for the highest and lowest number of barges per day, as the traffic is very unevenly distributed over the assumed 270 working days, and the capacity of the lock had to be taken into consideration.

The jury consisted of seven men of high standing and acknowledged experience. On May 1, 1902, there had been received 21 answers to the public appeal.

Ten of these proposals provided towing the barges the whole way through the canal by motor boats, the systems differing mainly in the electric current transmission. One reason for choosing tow boats probably was that the canal cuts through several lakes and that a substantial track for a locomotive across these lakes would be out of the question on account of swampy ground. On the other hand, by using tugs the banks were left free from any track and perfectly unhampered for loading and discharging the barges. This is a very important item, as it can be reasonably expected that within a few years the whole canal will be one continuous harbor. The writers of these ten propositions, however, have been given to grave deceptions as to the efficiency of the screw propeller, the difficulties of transmitting to boats power by overhead feed wires on a wide canal, and to the losses of energy in controlling the motors in as wide ranges as are necessary in this case. The maximum efficiency of a towing, screw-propelled boat, taking the current by a trolley from an overhead feed wire, can be assumed to be about 33 per cent. at an average pull. Increasing or lessening the pulling power makes the efficiency drop close to only 15 per cent. In case storage

batteries are used the loss is still greater, as another drop of about 25 per cent. between the charging and discharging of the batteries must be figured with. The efficiency of the electric trolley locomotive is considerably higher and it has been found to be about 36 per cent. for small, 60 per cent. for medium, and 65 per cent. for maximum power. The locomotive therefore uses less than one-half the current of the tow boat. This fact settled the question as to what method of traction to adopt for those parts of the canal which could be provided with a track. The next thing was to pick from the ten described locomotives the one offering the most advantages. Of these ten designs three had natural adhesion to the track by their own weight, while in seven the adhesion was artificially increased, the authors of the latter apparently thinking that the natural adhesion would not be sufficient to overcome especially the initial pulling strain. Among these seven proposals was one providing a rack and pinion mechanism; another one sought to increase the friction by spring power in a

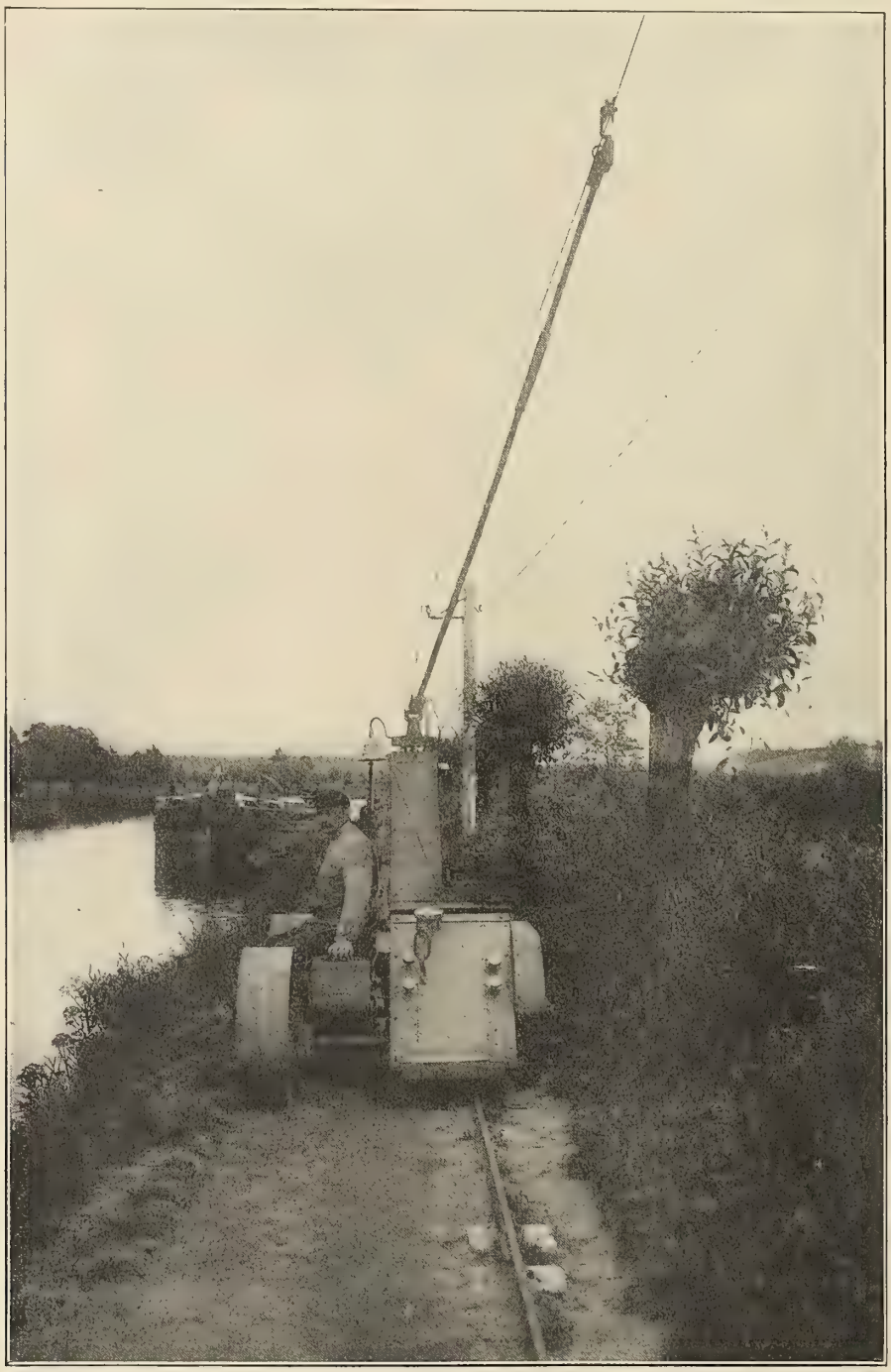


FIG. 3.—KOETTGEN LOCOMOTIVE NO. 1, ON FINOW CANAL.

however not sufficiently effective way. The other five designs use either the pull itself for pressing the wheels under an angle to the rail or else increase artificially the weight of the locomotive by strong magnets close to the rails. The general tendency was to keep the locomotive as light as possible for cheapening the building expense

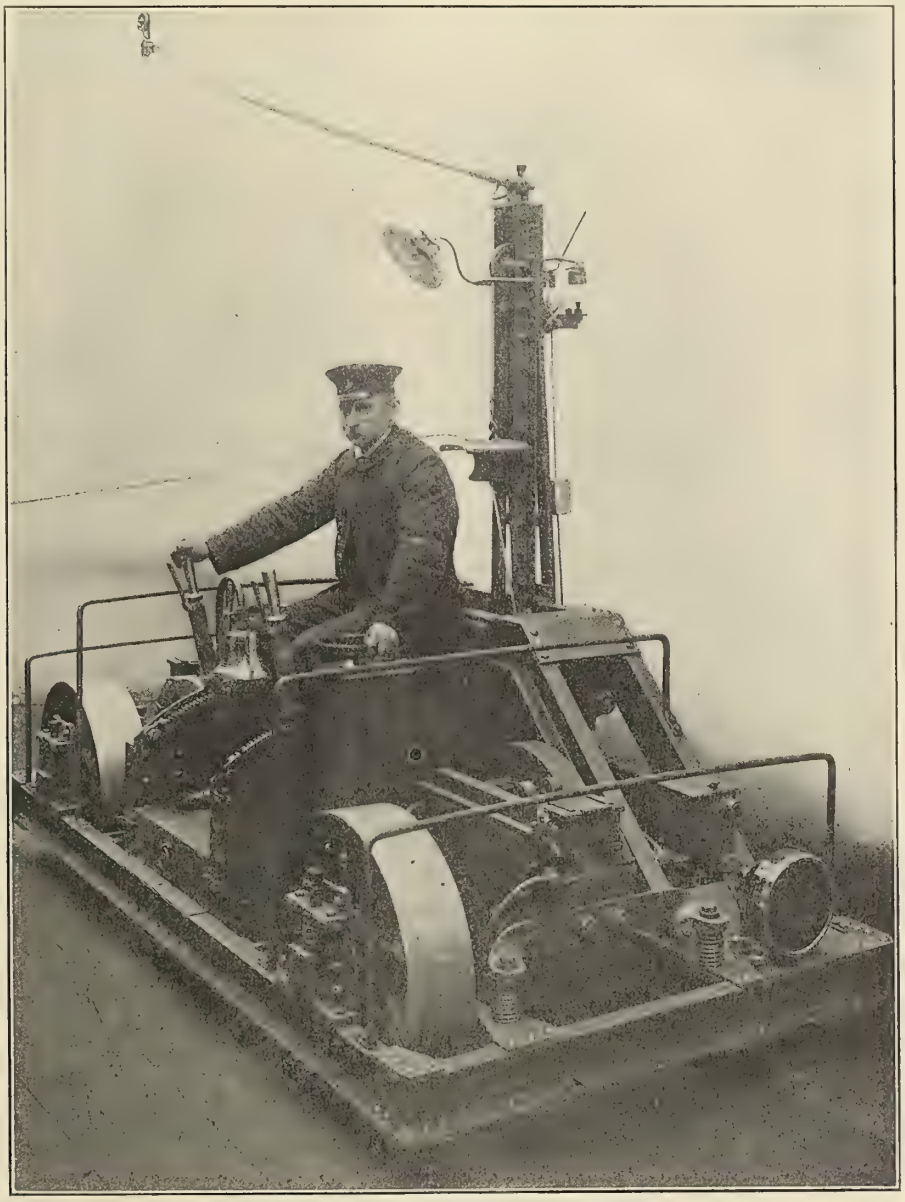


FIG. 4.—KOETTGEN LOCOMOTIVE NO. 2, SHOWING THE SLIDING ROPE GUIDE.

of the locomotive as well as of road bed and track, and increasing the adhesion artificially to the amount required.

It is, however, to be doubted if a light-built, more or less complicated machine of the above character is the right thing for a canal hauling device. The handling of barges is very rough work, and the strain on the rope will be anything but uniform. Besides the locomotives are to be run by cheap men. Therefore, simple, easily understood machinery must be looked for, that will be kept in good working order without special care, and that will stand well the many jerks in service. The operation of the canal locomotive resembles that of the ordinary trolley street car. Everybody knows of the great difficulties and the unexpected heavy expense of the upkeep of the mechanical and electrical outfit of the street cars. The present task is, however, somewhat easier, as the canal locomotive will naturally not stop every few hundred yards, and the range of speed is considerably smaller.

As to the kind of current, eleven of the competitors proposed to use direct current and ten three-phase alternating current. Of these ten advocates of alternating current, however, nine also admitted the good, time-tested qualities of the direct current motor for traction purposes. The more complicated wiring of the two and three phase systems is especially felt at the switches. On

the canal the switches are of practically no importance, as there is no absolute need of any at all in the main line. For taking the locomotives out of the main track the trolley can be shifted by hand. The necessity of using tow boats for some parts of the canal is a strong argument in favor of direct current, as the storage batteries require this kind of electric energy for charging, and the transmission of two or three phase current to the tow boats by trolley is more complicated.

As to the methods of transmitting the current from the wire to the locomotive or boat, seven provide poles and rollers, as used on the street cars, and five use small trucks, running on the wire and being pulled along by the locomotive or tug by a light cable. Five authors advocate an arrangement like the trolley automobile invented by Lombard-Gerin. It consists essentially, as shown in Fig. 7, of a small carriage running on the feed wires, propelled by a separate small motor, keeping it always ahead of the towing boats and allowing comparatively free manœuvring sideways. Three of the locomotives have short levered, sliding contacts for taking the current.

Coming now to the financial and commercial part of the six best propositions, which received the prizes already mentioned, we will not consider the figures of the cost of buildings and machinery, the running expenses and the cost per ton mile ton of freight according to the ideas of the authors, but give these items brought to the same level in order to afford a fair comparison.

The authors differed somewhat in their figuring basis, especially as to the source and cost of current, although this part of the traction plant was practically eliminated in the public announcement by giving a fixed price for

TABLE I.

System.		Capital to be Invested.	Yearly Running Expenses.	Expense for Towing One Long Ton (2,240 pounds) of Freight One American Mile.
				Cents.
I. Direct current locomotives.				
a. Koettgen	*a.*	$275,000	$52 300	2.89
	b.	469,000	83 000	2.74
	c.	505,000	125,000	2.07
b. Feldmann	*a.*	334,000	55.600	3.05
	b	583.000	89 800	2.97
	c.	618,000	131 000	2.15
c. Rudolph	*a*	281,000	52.400	2.89
	b.	462.000	81.000	2.70
	c.	495,000	122,000	2.03
II. Three-phase current locomotives.				
a. Fellenberg	*a.*	264 000	50.800	2.82
	b	474,000	84,600	2.78
	c.	497 000	123 500	2 03
b. Vering	*a.*	205,000	46.300	2.54
	b.	371,000	77,200	2 54
	c.	386,000	114,400	1.88
III. Storage battery boats	*a.*	387 000	101.500	5 56
	b.	627.000	162.500	5.36
	c.	716,000	258.500	4.27
IV. Trolley boats with direct current	*a.*	306,000	75,800	4.19
	b.	452,000	116,800	3.84
	c.	500,000	187.500	3.05
V. Trolley boats with three-phase current	*a.*	295.000	79.400	4.35
	b.	488,000	129,000	4.22
	c.	555,000	207,000	3.40

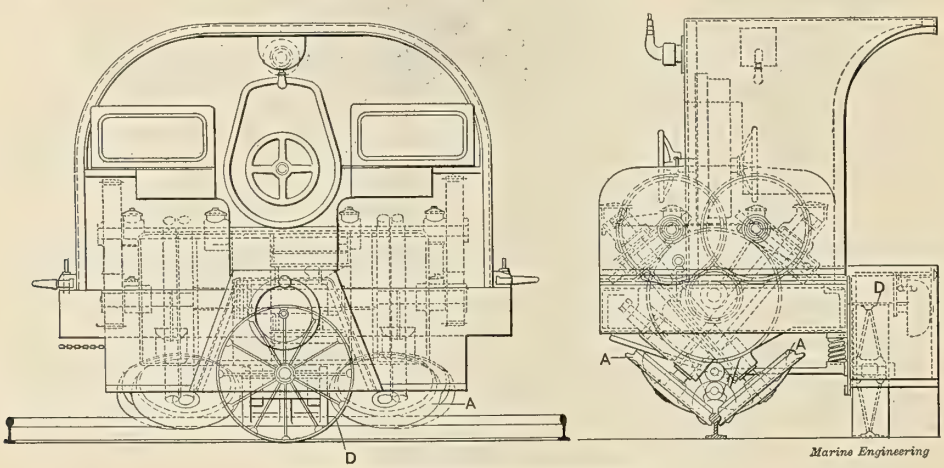


FIG. 5.—VERING'S ELECTRIC LOCOMOTIVE.

current to figure with. But some of the authors did not use this figure, but thought it essential for recommending their system to start from other suppositions. Therefore the government commission for looking into the canal traction question went over the prize work and changed the figures very carefully, bringing them to a common basis.

The following table, I., shows the results of these calculations. The figures are given (*a*) for one million tons of yearly freight traffic, (*b*) for two, and (*c*) for four and one-half million tons:

The table shows that the five locomotive systems do not differ materially in regard to their economy. The choice of which system to take will therefore turn on the question of simplicity, and certainty of the machinery, track, and power transmission.

The towing by boats, especially by those worked by storage batteries, is more expensive than by the locomotives, as could be expected from their low efficiency. It is, however, sure, that the economic conditions change favorably for the boats in case the yearly traffic is less than one million tons of freight. The smaller the traffic

the more favorably stand out the boat carrying storage batteries, even compared with the trolley boat.

In the following table, II., are given the percentages of the running expenses arranged according to their sources for the four most practical systems, and the yearly traffic (*a*), (*b*), (*c*), as before:

provide for enough men, locomotives, tow boats, etc., to take care of the maximum traffic. In order to make this large plant pay and ask reasonable towing taxes the barges could not be permitted to pass by the towing machinery and to use their own power or employ outside tugs to go through the canal.

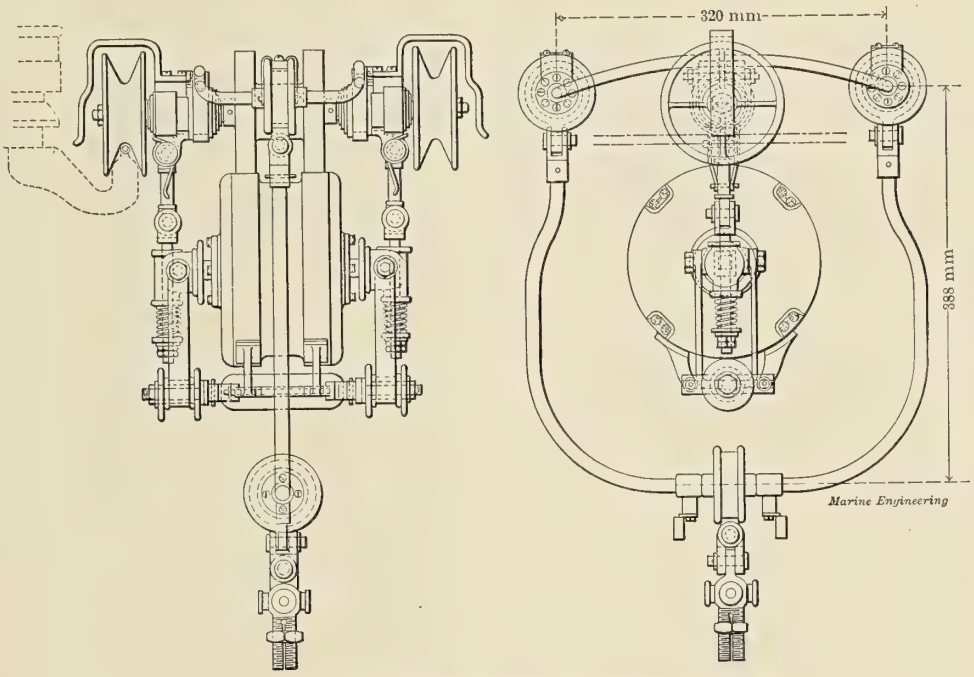


FIG. 7.—LOMBARD-GERIN TROLLEY AUTOMOBILE.

TABLE II.

System.		Expenses Originating from the Invested Capital, Interest, Sinking Fund, Renewals, and Repairs.	Management, Salaries, Materials, and Sundries.	Wages.	Current.
Direct current locomotives.	*a.*	42%	13%	26%	19%
	b.	46	11	24	19
	c.	33	11	33	23
Three-phase current locomotives.....	*a.*	46	13	23	18
	b.	50	10	22	18
	c.	36	11	32	21
Storage battery boats.....	*a.*	46	7	21	26
	b.	46	6	21	27
	c.	33	6	30	31
Direct current trolley boats.	*a.*	42	9	21	28
	b.	41	8	21	30
	c.	28	8	29	35

The county of Teltow applied for and received from the government the monopoly for electric hauling on the Teltow canal on May 7, 1901. This grant was necessary for two reasons: (1) The canal, and especially the lock, can only be utilized up to its full capacity during the rush, if the traffic is well regulated and crowding prevented. This is only attainable by obliging every barge entering the canal to use the hauling plant and allowing no stray boats to move about. (2) The county has to

As the result of the investigation the committee resolved to make some special trials with boats, the Koettgen and the Feldmann locomotives. This was decided upon for gaining more experience with this new matter and for collecting some desirable data. These trials were

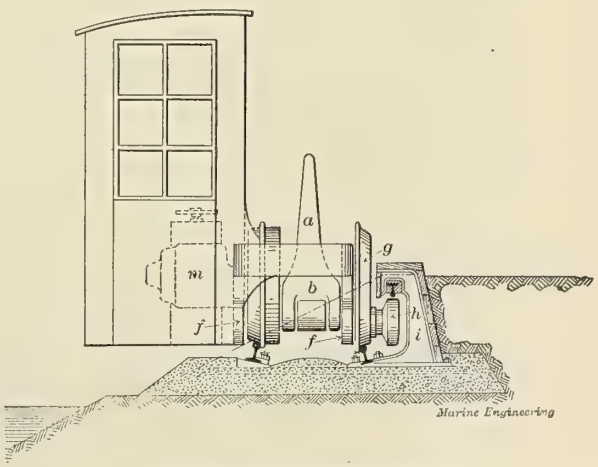


FIG 6.—FELDMANN'S ELECTRIC LOCOMOTIVE.

commenced during the fall of 1903, and those covering the main features have but just been completed.

The trials with the boats, following the Lombard-Gerin system, see Fig. 8, corroborated the high expense which was expected, so that the use of electricity has been

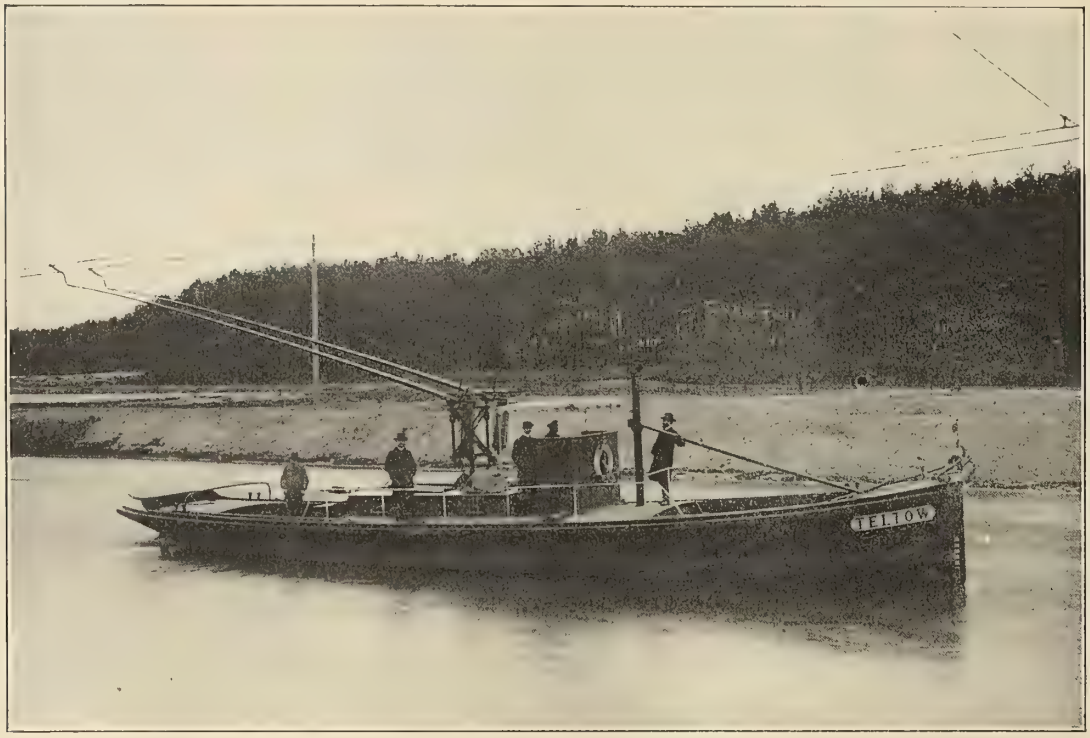


FIG. 8.—ELECTRIC TROLLEY TOWBOAT, BUILT FOR TRIAL ON THE TELTOW CANAL.

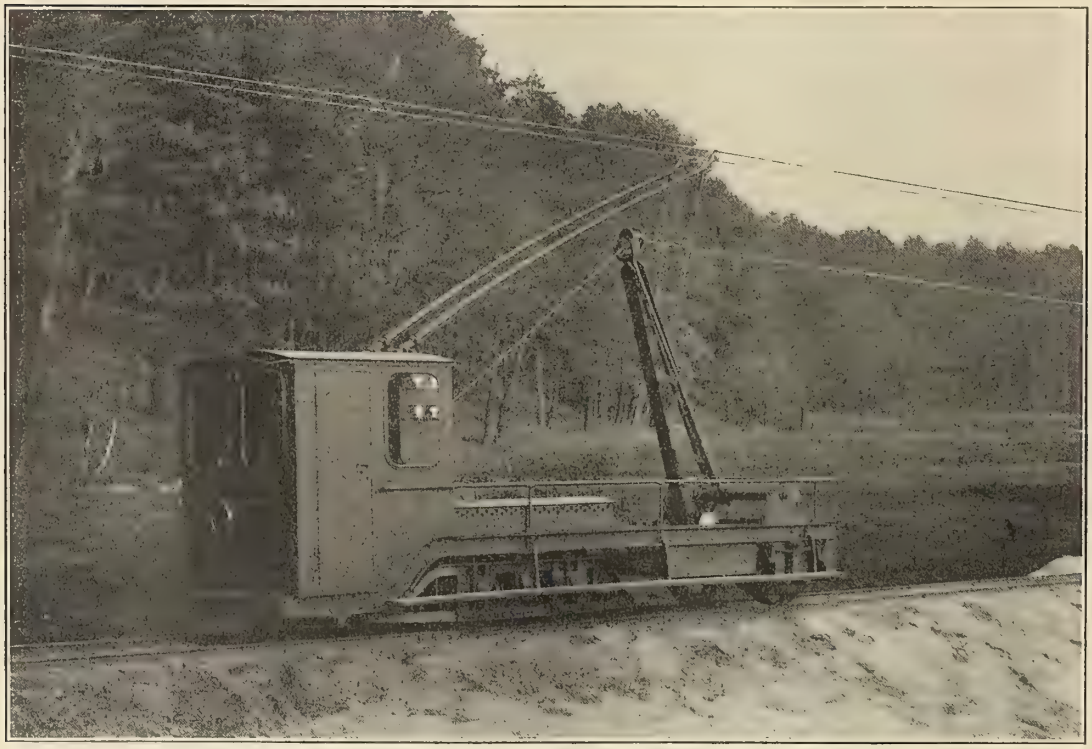


FIG. 9.—ELECTRIC LOCOMOTIVE FINALLY ADOPTED FOR TOWING ON THE TELTOW CANAL.

given up entirely for them. An alcohol motor boat was tried then in competition with a boat driven by a gas engine of the Ventzer Gasmotorenfabrik, having a producer gas generating apparatus on board. The latter boat has proved the best and will be adopted.

As to the locomotives, the two interested concerns merged into one, the Siemens-Schuckert Werke, and it

FIG. 11.—VIEW ON THE TELTOW CANAL, SHOWING ELECTRIC LOCOMOTIVE TOWING BARGES.

was decided to experiment only with the Koettgen locomotive, which had received the first prize. A locomotive of 2,200 pounds pulling power, see Fig. 9, having a weight of about 14,000 pounds, was built to run on a regular double track of rails of 15 pounds per foot and 39.37 inches (1.0 meter) gage. The locomotive has three axles, the two front ones being united in a separately turning truck. Each of these two latter axles is driven by a train of gears and an independent motor of about 10 H. P. The drum for carrying, winding, and unwinding the tow rope, and also the swinging lever, with which this Koettgen locomotive No. 3 was provided to lift the rope over the usual obstacles, were driven by separate electric motors, easily controlled by the motorman from his stand. Direct current of 550 volts was transmitted by the regular trolley car pole. The trials which took place on the Teltow canal, were conducted according to an elaborate programme, and the locomotive has come up to all expectations so well and even surpassed them, that it can be put into service without any hesitation.

As the canal passes not far from the Potsdam magnetic observatory the return current is not carried through the rails and copper binders on this section of the line, but by a second overhead wire and a second trolley pole. This arrangement is adopted for a little over 6 miles.

rope lifted up. An experimental grade of track was built for determining the climbing qualities of the locomotive.

For 2,000,000 tons of freight 15 locomotives are necessary to run on schedule, the tows leaving every 90

FIG. 12.—TOWS PASSING EACH OTHER IN OPPOSITE DIRECTIONS, ILLUSTRATING THE ROPE-LIFTING DEVICE ON THE LOCOMOTIVE.

For the electric traction the canal is divided into four sections, each terminating at a bridge. Here the barges change the locomotive and the latter crosses to the other side of the canal to return. This arrangement was found to work better than to let the locomotives run all the way through.

The running expenses, as given in the prize projects, show evidently that under the assumptions considered there is no profit whatever; the latter tests, however, brought out the remarkable result that the number of barges forming a train could be doubled and the power of the locomotive reduced from 3,300 pounds to a little over 2,400 pounds.

It was further corroborated by experiments (see Fig. 10) that the speed of about 2 1-2 miles is the most economical. Below this speed the current is not appreciably less, while above it rises quickly. For instance, at 2.81 miles speed, the outlay for current is 20 per cent. more, while the total time of going through the canal is only reduced from 10 hours 15 minutes to 9 hours 20 minutes; that is a gain of only 9 per cent.

The length of the tow rope having the minimum resistance of the barge was determined to be about 80 yards. The steering of the barges against the oblique pull of the tow rope presented no difficulty whatever, as the bargemen understood at once how to set the helm. A tow is clearly illustrated in Fig. 11. Fig. 12 demonstrates the working of the rope lifting device on the locomotive. It shows the locomotive with a barge just before passing on the outside of another one, with the

minutes. Twenty have been ordered, however, to be prepared for emergencies. For 3,000,000 tons of freight

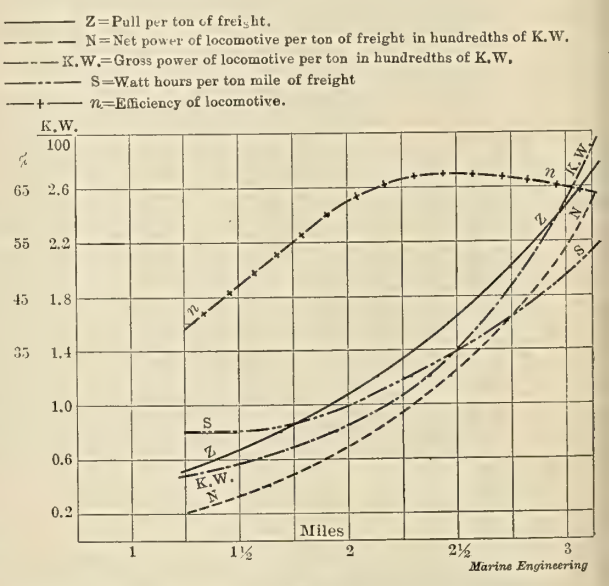


FIG. 10.—TOWING DATA FROM TRIALS ON THE TELTOW CANAL.

27 locomotives will answer the requirements; the tows leave every 70 minutes. For 4,000,000 tons 34 locomotives will be operated, the tows being 50 minutes apart.

TABLE A.—COST OF ELECTRIC HAULAGE PLANT ON THE TELTOW CANAL.

For Yearly Traffic in Gross Tons of Freight.	2,000,000 Tons.	3,000,000 Tons.	4,000,000 Tons.
1. Forty-four miles of roadbed and track, 30 switches, and 4 bridges	$317,500	$317,500	$317,500
2. Fifty-five miles of electric equipment	85,000	85,000	85,000
3. Locomotives of the required number; 2,650 lbs. maximum working pull at 2½ miles speed; 3 axles, weight about 14,300 lbs. apiece	57,200	77,200	97 300
4. Locomotive sheds and repair shops	10,700	10,700	10,700
5. The required number of 75 H. P. gas engine tugs, and slips	97,600	114,100	147,800
6. General expenses for projects, prizes and cost of experiments	32,300	32,300	32,300
Totol	$600.300	$636,500	$690,600

TABLE B.—RUNNING EXPENSES FOR ELECTRIC HAULAGE PLANT ON THE TELTOW CANAL.

For Yearly Traffic in Gross Tons of Freight.	2,000,000 Tons.		3,000,000 Tons.		4,000,000 Tons.	
	Total.	Cents per Mile Ton.	Total.	Cents per Mile Ton.	Total.	Cents per Mile Ton.
1. Electric current for locomotives	$9,050	0.234	$12,350	0.214	$14.400	0.187
2. Anthracite for producer gas boats	1,250	0.031	2,860	0.031	2.500	0 031
3. Wages	18,850	0.488	23,840	0.413	30,700	0.402
4. Upkeep and repairs	11,400	0.296	12,900	0.222	15,000	0 195
5. Interest and sinking fund	27,100	0.702	29,200	0.498	31,200	0.402
6. Depreciation	10,700	0.277	11,950	0.210	13,800	0.179
Total	$78,350	2.028 cents.	$92,100	1.588 cents.	$107,600	1.396 cents.

TABLE C.—RUNNING EXPENSES FOR STEAM TUGS INSTEAD OF THE ELECTRIC LOCOMOTIVES.

For Yearly Traffic in Tons of Freight.	2 000,000 Gross Tons.		3,000,000 Gross Tons.		4,000.000 Gross Tons.	
	Total.	Cents per Mile Ton.	Total.	Cents per Mile Ton.	Total.	Cents per Mile Ton.
1. Steamer coal for tugs	$11,800	0.308	$17,750	0.308	$23,650	0.308
2. * Anthracite for gas boats	1,250	0.031	1,860	0 031	2,500	0.031
3. Wages	26,500	0.685	36,000	0.624	49.300	0.636
4. Upkeep and repairs	13.900	0.363	18,800	0.324	24,200	0.312
5. Interest and sinking fund	13,400	0.347	17,150	0.296	21,700	0.281
6. Depreciation	9,300	0.242	12,140	0.211	15.550	0.202
Total	$76 150	1,976 cents.	$103,700	1.794 cents.	$136,900	1.770 cents.

*For convenience and direct comparison the gas engine boats remain in the calculation.

As soon as 5,000,000 tons are exceeded the plant will be in operation day and night during the rush season.

In the opposite tables are compiled the figures constituting the basis for the plant as authorized and building on the Teltow canal at present. It may be remarked that in the running expenses the empty barges have not been considered, to be on the safe side. The figures per ton mile of freight appear rather high compared to the general idea of steamship freight on canals, which is in Germany about 1.2-1.6 cents per ton mile. But it must be kept in mind that the monopoly obliges the county of Teltow to be prepared for the maximum traffic, and to have at all events an adequate plant. The interest of the sums spent for the large rolling stock, etc., increase the running expenses considerably. Moreover, the men have to be kept throughout the year, while during certain periods quite a number of them will have little to do.

In the tables is also shown the financial effect of a plant consisting of steam tugs alone. The first outlay is, especially for a small, initial traffic, considerably lower than for the locomotive traction system. The running expenses are not far from those of the locomotives in the beginning; but while the latter drop with the increasing traffic, the former stay nearly the same. Therefore the locomotive system is the more economical one in the long run. Furthermore, it is also more desirable for two reasons: first, the tugs being practically banished from the water, the road is freer for the barges—a larger number can enter the canal without crowding; second, the upkeep of the canal bed and banks is appreciably cheaper, because, in the absence of tugs, the damaging effect of the screw propellers, bow and stern waves, etc., is entirely avoided.

For the photographs, diagrams, and most of the data, I am indebted to Mr. Erich Block, superintending engineer of the Teltow canal, and to Mr. Koettgen of the Siemens-Schuckert Company.

New Steamships for the Hamburg-American Line.—Two ships, of the intermediate type, of the largest dimensions, are now under construction for the Hamburg-American line. They are to be twin-screw vessels of about 17 knots sea speed, enabling them to make the trip between New York and Plymouth or Cherbourg in about 7 1-2 days. The innovations introduced by this company in former steamers will be found on the new vessels, such as the grill room, restaurant, and gymnasium. Each ship is also to be fitted with Turkish baths and passenger elevators through all the five decks on which there are passenger accommodations. The *America,* which is being built by Harland & Wolff, Belfast, will be ready for service next summer. Her dimensions are: Length over all, 700 feet; breadth, 74 feet; depth, 53 feet; gross tonnage, 23,500 tons; displacement, about 35,000 tons; cargo capacity, 15,000 tons. The other vessel, the *Kaiserin Auguste Victoria,* will be ready in the spring of 1906. She is being built by the Vulcan Shipbuilding Works at Stettin, Germany. Her dimensions are: Length over all, 705 feet; breadth, 77 feet; depth, 53.9 feet; gross tonnage, 25,000 tons; displacement, about 40,000 tons; cargo capacity, 16,000 tons.

TWELFTH ANNUAL MEETING OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

The twelfth annual convention of the Society of Naval Architects and Marine Engineers was held in New York on Thursday and Friday, November 17 and 18, 1904.

The first session was called to order on Thursday at 10:25 A.M., with the president, Francis T. Bowles, in the chair. The first business was the report of the secretary-treasurer, which was receievd and adopted. The statement of resources and liabilities shows that the society's finances are in most excellent condition. The total resources are $21,072.10, while the liabilities are none. The council presented the following lists of applicants for admission to the various grades of the society; the names were read and upon motion the applicants were unanimously elected. The membership of the society on November 15, 1904, was 844, a slight decrease from a year ago.

Honorary Member, 1.—Sir William White, K.C.B., etc., late chief constructor, British navy.

Members, 19.—Lawrence Stowell Adams, naval constructor, U. S. Navy, Union Iron Works, San Francisco, Cal.; James Donald, naval architect, New York Shipbuilding Company, Camden, N. J.; James Oliver Duke, assistant superintendent, Kensington Shipyard Company, Philadelphia, Pa.; Edward Stamford Samuel Hough, engineer surveyor, Bureau Veritas, San Francisco, Cal.; Frank Jeffrey, vice-president, Union Iron Works, San Francisco, Cal.; Charles M. Jones, draftsman, Municipal Government, New York city; William Joseph Luke, naval architect, John Brown & Company, Ltd., Clydebank, Scotland; Henry Lysholm, superintendent of hull construction, New York Shipbuilding Company, Camden, N. J.; John H. Macalpine, naval architect and consulting engineer, 4504 Pine street, Phliadelphia, Pa.; Percy Howe Middleton, vice-president, H. I. Crandall Company, 102 Bates street, East Boston, Mass.; William Brackett Stearns, naval architect, Marblehead, Mass.; Warren Taylor Berry, assistant superintendent marine construction, New York, New Haven, and Hartford Railroad Company, New York; William J. Drew, instructor in naval architecture, School of Mechanical Arts, San Francisco, Cal.; William Neill Howell, superintending engineer, Eastern Shipbuilding Company; Horace Thompson Sloan, Jr., chief draftsman, floating equipment, Pennsylvania Railroad Company, Jersey City, N. J.; Charles Gordon Curtis; Amasa Trowbridge, adjunct professor mechanical engineering, Columbia University, New York; James C. Wallace, president American Shipbuilding Company, Cleveland, Ohio; George Warrington, superintendent construction, U. S. Lighthouse Establishment, Washington, D. C.

Promotion from Associate to Member, 8.—John D. Beuret, naval constructor, U. S. Navy, Bureau of Construction and Repair, Navy Department, Washington, D. C.; Willis Gorman Dodd, president, Union Iron Works, San Francisco, Cal.; Thomas Murritt Dick, professor of mechanical engineering, College of Agriculture and Mechanical Arts, West Raleigh, N. C.; Godfrey L. Smith, draftsman, Newport News Shipbuilding and Dry-Dock Company, Newport News, Va.; Charles Franklin Willard, instructor of marine engineering, Massachusetts Institute of Technology, Boston, Mass.; George Eugene Barrett; Theodorus S. Bailey; Henry Capdevielle.

Associates, 11.—William Allison Fuller, estimate clerk, New York Edison Company, 55 Duane street, New York, N. Y.; Alonzo Gartley, general manager, Hawaiian Electric Company, Honolulu, H. I.; Henry S. Grove, president, The William Cramp & Sons Ship and Engine Building Company, Philadelphia, Pa.; Andreas Petrus Lundin, Pacific Mail Steamship Company, San Francisco, Cal.; Fred. McQuesten, vice-president, The George McQuesten Company, 27 Kilby street, Boston, Mass.; Louis Horatio Turner, surveyor, Bureau Veritas, San Francisco, Cal.; Fields Seeley Pendleton, manager, Pendleton Brothers, Belfast, Me.; Hans Georg Hibbinghaus, Commander Imperial Navy, naval attaché, German Embassy, Washington, D. C.; Edward Murray Speakman, engine daftsman, Fairfield Shipbuilding Company, Glasgow, Scotland; William Culver Davis, mechanical and constructing engineer, 242 Donaldson avenue, Rutherford, N. J.; James Speers Dickie, draftsman, transport service, San Mateo, Cal.

From Junior to Associate, 1.—Axel E. Zetterman.

Juniors, 9.—Reuben B. Clark, naval architect, E. H. Godshalk & Company, Philadelphia, Pa.; Harold Mason DeGraw, draftsman, office of superintending constructor, Newport News Shipbuilding and Dry-Dock Company, Newport News, Va.; Walter Cook Keenan, draftsman, Department of Construction and Repair, Naval Station, New Orleans, La.; Everett Parker Lesley, graduate student, Cornell University, Ithaca, N. Y.; Granville Smith, hull draftsman, Maryland Steel Company, Sparrow's Point, Md.; Arthur Osborne Roberts, draftsman, Bureau of Construction and Repair, Navy Department, Washington, D. C.; John Hilbrish Well, secretary, The Matthews Boat Company, Bascom, Ohio; N. L. Snow; Arthur H. Sherwood.

Promotion from Junior to Member, 3.—Charles H. Godbold, Jr., draftsman, Union Iron Works, San Francisco, Cal.; Robert Stanley Height, assistant to superintendent, Old Dominion Steamship Company, New York, N. Y.; Clifton Yeomans, draftsman, Union Iron Works, San Francisco, Cal.

Admiral Bowles then delivered the presidential address, pointing out the fact that the year was notable because of the Russo-Japanese war. Its most vital factor was the command of the sea in eastern waters by the Japanese, who could not have entered upon the conflict at all had they not had a highly efficient and powerful navy. Referring to the *Slocum* disaster, the admiral declared that it would undoubtedly result in revision of the existing laws and rules of the steamboat inspection service, but that the matter must be carefully handled because of the many commercial and legal points involved, by no means least being the consideration of the adoption of non-combustible materials on vessels. The shipbuilding returns, he said, for large vessels for ocean traffic had been most unsatisfactory, only one such craft being on the ways; on

the contrary, the returns from the lake region indicated a brisk revival after the year's stagnation. The work of the congressional commission had done one excellent thing, the admiral thought, for the people as well as the technical men, for through the acts of congress ordering war vessels built which had no superiors anywhere in the world, it had shown first, that we can have a navy if we want it, and second, that in the same way we can have a proper merchant marine.

Upon the recommendation of the council all the present officers of the society were re-elected.

The President: Gentlemen, I would like to say to you that the council at its last meeting adopted a vote asking the executive committee to prepare and present a revision of the constitution and by-laws of this society, particularly with regard to the election of officers and members of the council, the object being to provide some progression in the election of officers in a manner corresponding to that customary in other societies. The chair would especially be gratified by adopting such a change, as the present method of election of officers seems rather crude.

In the absence of the author, the first paper was read by the secretary.

SIMPLE METHODS IN WAR SHIP DESIGN A NECESSITY.

by George W. Dickie, Esq., Member of Council.

ABSTRACT.

Since presenting a previous paper on this subject the author is more than ever impressed with the necessity of decreasing the number of complicated mechanisms in the equipment of war ships, especially in view of the fact that recently the equipment of a war ship has become much more involved. The scheme presented and illustrated by a set of plans is that a central passage be worked in the entire length of the ship, directly under the protective deck, and that this passage contain the pumping, ventilating and heating, and the communicating systems and electric cables of the entire vessel. Particular stress is laid upon the fact that in the present arrangement the connection by means of manifolds of, say, a fire pump to the bilge and boiler feed lines, is very inefficient, and that each pump should be designed for but one purpose. With this in view the drainage system is carefully worked out and simplified in the proposed scheme. Other simplifications proposed are the grouping of auxiliaries in a separate compartment, arrangement of steering gear, stowage of boats and coaling appliances. Throughout, the desire of the writer, who has had much experience in the design and construction of war ships, has been to reduce the number and intricacy of the necessary auxiliary mechanisms.

DISCUSSION.

Naval Constructor D. W. Taylor: Mr. President and Gentlemen: Personal remarks in the discussion of a technical paper before a technical society are clearly out of place. The papers which the authors give us are fair game for discussion—either praise or blame—but the personalities of the authors should, as a rule, not be mentioned. I think, however, in this case that we are somewhat warranted in departing from that very wise rule. Any one who did not know Mr. Dickie, and who read this paper, would regard him as a sour, sneering pessimist. Those of us who do have the pleasure of his acquaintance know that on the contrary he is a most genial optimist, full of the the milk of human kindness, and effervescing at times with wit and humor. In fact, when this paper has been carefully read, it will be found that Mr. Dickie has been unable, in many places, to keep down his optimism.

The title of this paper appeals to all of us—"Simple Methods in War Ship Design a Necessity." We all agree with the title and many of us preach it, particularly for the apparatus belonging to other people. Mr. Dickie has taken up in detail a number of items in connection with men-of-war—too many to discuss in detail—and what I have to say will be restricted to those features which, as a rule, are handled by the corps to which I belong.

Consider first Mr. Dickie's drainage scheme. That certainly has the great merit of simplicity; although I notice that the apparatus which he proposes to fit replaces only a part of the drainage now fitted. I sympathize very much with Mr. Dickie in his desire to simplify drainage, as I have preached the same means for many years with poor success; but I must say that I cannot agree with him as to the details of his method. Personally, I think the way to simplify drainage is to leave out about two-thirds without making any radical change in present systems. Suppose that a ship fitted with Mr. Dickie's scheme—a first-class battleship—should graze one of the uncharted rocks which bob up now and then and frequently do a great deal of damage: without damaging the structure of the ship as a whole or interfering with the propelling apparatus or disabling the ship in any way, it would probably knock a very large hole into Mr. Dickie's subway for drainage. The result would be that the captain of that ship would come into port as soon as possible and report that it was simply impossible for him to get a drop of water out of his ship except by bailing, and I am afraid that if there were other ships fitted that way they would probably be altered to the present complicated system.

Now, Mr. Dickie proposes to use a central passage for ventilation. The objection which he raises to the present system, on page 9, are very few really. He says if any ventilation is required over the whole ship every fan must be in operation to get it, although the amount required may be very little. The condition requiring very little ventilation is one which seldom arises.

He also objects to inlet cowls being fitted all over the upper decks. The fitting of these inlet cowls is a step in the direction of simplicity. It would not be very difficult to supply this independent system of fans with a supply main which led up in the superstructure, but it is much more agreeable to lead the air direct down to them. The great advantage of the present system which is pointed out by Mr. Dickie, is that it avoids piercing water-tight bulkheads with ventilation tubes with their complication of automatic valves, which, I believe, are supposed never to work, and the resulting danger to the ship. That was a very real and serious danger, and has been gotten rid of, not only in our service, and certainly in the English service, but I think

practically in every service in the world now, by fitting a number of electric ventilating fans. That could not be done until electricity was used for ventilating fans almost exclusively, because it would be practically impossible to fit a large number of small steam fans all over the ship. The network of steam and exhaust pipes would really be prohibitive.

Mr. Dickie proposes to use the central passage for ventilation. That is a case where his optimism crops out. He believes that nothing ever could or would happen to the central passage, and that he could use it with perfect safety. As a matter of fact, the central passage runs nearly the whole length of the ship, over 400 feet, and in places it dips down in the neighborhood of the keel; it is close under the protective deck nearly everywhere, and is undoubtedly subject to damage, and we cannot proceed on the assumption that it will not be damaged. People who are designing men-of-war have necessarily to be pessimists; they have got to assume that unpleasant things will happen and they have got to endeavor to provide for them. With Mr. Dickie's system there is no water-tight subdivision as long as the ventilation is in operation. Every compartment in the ship is in communication with every other compartment. He fits valves by which it can be shut off, and I presume the attendant in the central passage who has to do a good many other simple things, is to work these valves. I am afraid that attendant will have a job which is a good deal more difficult than the job of the slave of the lamp that we read about in the "Arabian Knights." The slave of the central passage has not only to work these valves, but has to turn on hot air and cool air for twenty or thirty state rooms, and also provide hot water at the desired temperature at each bath.

But to come back to Mr. Dickie's present system, there are a few other objections to it apart from the objection to the danger of the water-tight subdivision. In the first place, the fans are all fitted well forward, while the bulk of the air is utilized aft. The engine rooms and the dynamo rooms require probably more air than all the rest of the ship put together. This means that the air must be forced a long distance through this central passage, which has a good many pipes and other obstructions in it, and not well adapted for an air vent. Incidentally the slave of the central passage would be working in a gale of wind all the time. The pressure that he proposes to use of one ounce would undoubtedly cause a great deal of trouble if it were maintained in the central passage, for the reason that air escaping from a pressure of one ounce moves with great velocity —a great deal more than the 2,000 feet per minute which we generally consider. It must be put in ventilation ducts. The result would be a very serious disturbance of the people on board by the whistling of the air. Incidentally, there would be a good deal of waste of power. The pressure against which our fans work now seldom reaches as high as five inches, which is 5-9 of an ounce, a little over half of what Mr. Dickie proposes.

Another objection to this system is this: Mr. Dickie says on page 8: "More than half of the middle length of the ship under the protective deck is full of heated surfaces to something like 300 degrees." He then shows how he proposes to remove that heat, a proposition which was not adopted. This ventilation passage will act very effectively as a remover of a good portion of the heat. This central passage, which is threaded between the boilers at a temperature of 300 degrees, will undoubtdly be very hot. I think the central passages we have now on one or two ships which are not in close contact with boilers are by no means cool. In the tropics, where ventilation is most needed, we have very great complaints in one or two cases where the air for ventilation was delivered at a temperature only three or four degrees higher than that of the atmosphere. I remember the case of a monitor particularly, where there was very strong condemnation of the ventilation, and it was found that the temperature in the quarters was only three or four degrees above the temperature of the outside air (there is no doubt that this air will be delivered in the quarters at more than three or four degrees above the temperature of the outside air) and the first time that ship made a cruise in the tropics and came back there was a better ventilation system put in.

There are a few other minor objections to Mr. Dickie's system, any one of which would prohibit it. There is danger, by the bursting of a steam pipe or boiler, of damage being done to the central passage and vicinity, causing the central passage to be full of hot steam, which would disable the whole ship until the steam was gotten under control and the central passage cooled down. But there is a much more serious danger than that which has been brought into prominence by recent events. Mr. Dickie proposes to supply this central passage by a large duct which leads up just under the pilot house and has no protection. Well, the fumes of modern, high-explosive shells are deadly. If persons are exposed to strong fumes they are killed instantly; if to rather dilute fumes, simply stupefied. A single shell exploding in Mr. Dickie's duct would either kill or stupefy two-thirds of the people on the ship, and it would be some time before those who were not killed would recover from the effects. I think that alone, for a man-of-war, would prevent the adoption of Mr. Dickie's central passage idea as regards ventilation.

I notice on page 12 Mr. Dickie makes the remark in connection with a certain report of tests of a power door—he says: "It is stated that the door tested, as compared with the other, was simpler in construction, was tight, would stand ordinary neglect better, but would not stand gross neglect so well," and he considers the construction of the words quite hard to understand. I fully agree with him in that respect; but the words are Mr. Dickie's words, and not the words of the report. Mr. Dickie has paraphrased the report, and I will read you now the actual wording to which he refers, substituting the harmless terms "white" and "black" for the actual names of the doors in question:

"The white door as compared with the black door has the great advantage of simplicity; it can be made absolutely water tight against thirty-five feet head more readily; but would probably not show superior water tightness in service; it does not provide as completely against possible contingencies as the black design; it will require less care to keep it in first-class order, but will suffer more if given gross neglect."

Mr. Dickie, like all the rest of us, would like to get rid of voice tubes, and he says that the telephone has been brought to such perfection that there need be no doubt as to its reliability on board ship. That was a matter a little out of my line, but I am well aware of the fact that officers who have charge of such matters have been experimenting for years in the hope of getting a reliable telephone for use on board ship, and they do not admit yet that they have succeeded. Mr. Dickie's optimism is, I think, a little ahead of the actual state of the art. There are installed upon the most recent cruiser two telephones of a new design, which are supposed to be the best obtainable now. In conversation with an officer who was on the trial, I asked him how these telephones worked. They were put in for trial. He said that at times they worked perfectly. At other times they were absolutely unintelligible. He said that the people working them apparently were not quite sure of the cause of the trouble. I have no doubt that a telephone will come for use on board ship, and it is very much needed, because, on one of these 500-foot ships particularly, voice pipes are very inefficient.

There is one other matter Mr. Dickie tells us as regards several items that he has given careful attention to. I do not believe he did that as regards the proposition for coaling ships. If the problem of coaling ship was simply to get the coal over the side, and if the ship was floating in a sea of coal, I think Mr. Dickie's plan would probably work very well; but it does not apply to actual conditions. In the first place, the apparatus which he shows in Plate 4 will not fit into place. The center line of the bucket is between seven and eight feet, I think, out from the side of the ship, and the track would certainly have to be braced; in fact, he shows braces. These braces would have to be rigged by a brace seven or eight feet long and probably two or three inches in diameter, which would not be very easy to handle. He would have to provide an outfit of derricks and other gear in order to rig his coaling plant. This projection extends but seven or eight feet beyond the side of the ship, and it was evidently impossible to carry the bucket much further off or further away from the side of the ship; when you allow for the fact that the barge must have some clearance, means that the bucket commands only the extreme edge of the coaling barge. The barge may be thirty feet wide. The result is that to get coal into the bucket it will have to be transported some distance by shoveling, or wheeling, or some method, and I do not believe that it would be loaded quite as fast as Mr. Dickie thinks. Incidentally, this projection from the side of the ship and between the barge sticks up some distance above the water when it is light, and there would be very serious danger of wiping the whole thing off the first time the ship was coaled. These are minor matters, and with great care and skill it is possible that the outboard turrets could be made to work.

Now, Mr. Dickie gets coal over the side of the ship and dumps it into a hopper. The real difficulty with coaling a man-of-war is due to the fact that they have a large number of bunkers and that it is necessary to fill the bunkers quite full. That means you cannot simply dump the coal into the bunkers; it has to be trimmed into the bunkers more or less. There has been bitter complaint about trimming coal in bunkers. Apparently human flesh and blood cannot stand trimming coal more than a very short distance down in a bunker. That is universally agreed upon by the people who go to sea. Well, the result has been that with our ships at present we use a large number of coaling scuttles. On a ship such as Mr. Dickie refers to we have twenty-five or thirty on a side. Naturally the more coaling scuttles you have in your bunkers the less trimming of coal is necessary. You simply dump the coal through the most convenient scuttle. When that condition arose there were bound to be very great difficulties in getting coal trunks down from the upper decks to the berth deck level, to get the coaling scuttles into the berth deck. There are all sorts of things in the way. The ship is full of a large number of fittings, and in addition to that the upper deck is not an open, clear deck; it is interspersed with vents and ventilators and a number of other things, and the result was that instead of attempting to run twenty-five or thirty fixed or portable coaling trunks, portable coaling trunks were used between decks, but they were very difficult to stow.

The present system, which is just being tried in the navy, is to feed the coal down through two decks in comparatively large quantities from five or six hatches on the side, the hatches being also used as skylights. When it reaches the berth deck level, the coal being delivered in bags, the bags are transported to the nearest scuttle and dumped. Experience with dividing the coal on the upper deck indicates that if the coal can be fed down through the hatches there is no difficulty in separating it and dumping it on the berth deck as rapidly as required. There are, of course, objections to this system, as to every other, which I shall not go into.

Now, what does Mr. Dickie do? Instead of twenty-five or thirty coaling trunks he has just three on each side. If you look at his plan and the plan of his protective deck, you will see that using this coaling scheme it would be necessary in some cases to trim the coal from sixty to seventy feet after reaching the bunker, pass it through the door, and presumably lifting it up again and piling it up in the bunker. There is no doubt about it that that system, obviously, on the face of it, is impossible for coaling ship. It could only be made possible by fitting twenty-five or twenty of Mr. Dickie's outboard gears to a similar number of fixed trunks, a thing which has not been found possible in the system which we had to give up a few years ago. That was a fatal objection to Mr. Dickie's system. The reduction which he uses in the number of trunks would be utterly impossible—the amount of trimming in bunkers which would be required of it. I am afraid that Mr. Dickie has also allowed his optimism to get the better of him in this case, because I can assure him if such a system was fitted on board ship it would never be used but once.

COMMANDER W. HOVGAARD: Mr. President, I think all naval architects will sympathize with Mr. Dickie in his efforts to simplify the construction and outfit of war ships. Naval constructors in all countries have to struggle against the great number of claims to improvements and innovations largely forced upon them by other branches of the service, claims which arise as a

natural consequence of the rapid technical development. The naval constructor has to determine to what extent such claims can be fulfilled without undue detriment to the other interests, and notably without sacrificing fundamental principles of design. Every proposal should be tested by examining whether or not we depart from such principles in carrying it out. The principle which is most important, first of all, to bear in mind in ship design, is that of the safety of the ship. I propose to review some of the important modifications proposed by Mr. Dickie in the light of this principle of safety.

First of all, the central passage is not a new feature. It is already introduced both in this and in at least one other navy. What is new in Mr. Dickie's proposal is that he has carried the central passage nearly to the ends of the ship, and that for part of its length it is placed very close to the inner bottom. While it is true that the midship portion of the central passage has an almost perfectly protected location, this is far from being the case near the ends, notably forward, where the passage is liable to damage by grounding, torpedo explosions and ramming. What happens if a serious leak is produced in the central passage? In a very short space of time it will be flooded from end to end, for there are no water-tight doors in the passage; the drainage and ventilating systems will at once be paralyzed, the central commanding station will be put out of action, and, worse than this, the numerous ventilating trunks that lead from the central passage out to the ship are likely to act as so many ducts for the water, and the water will pour into all the important compartments of the ship and the engine room. This danger could, of course, be largely obviated by automatic valves, but whether they will really act in time of emergency I suppose is somewhat doubtful. On the whole, the advantages by the proposed extension of the passage do not seem to me to outweigh the increased risk.

As to drainage, the system proposed by Mr. Dickie embodies two steps in departing from the present. First, the drain is placed in the double bottom; secondly, it is built into the ship, so that one of the containing walls of the drain is part of the outer shell. That is not a new step; that is, on the contrary, a retrogression to former installations used in the English navy, and I believe also in this navy, and still used in the French navy, where the main drain pipe is placed in the double bottom, suspended in the inner bottom. The other step that he proposes is, instead of a drain pipe, to build the drain into the ship, into the double bottom itself, so that one of the containing walls is the outer bottom or keel plate of the ship. Here, of course, there is a very serious danger of damage, and I think, besides what Mr. Taylor pointed out, there is a probability that in case of grounding, not only the drain duct may be damaged itself, but also one of the large compartments, say one of the boiler rooms, and no one will know whether the drain duct is damaged or not. What happens is this: that the man in the central passage will open the drain valve to the boiler room in order to begin to pump out, and then the water will flow from the sea into the pumps, and it will flow from the sea into the flooded compartment, and it may not always be easy to see from where the water comes. I think that is a very serious danger.

I think on the whole that the system adopted by the French, where they use, beside the circulating pipes, powerful centrifugal pumps at the end of the main drain, is very advantageous. I think there is some objection to having all the pumping power, so to speak, at one end of the main drain, and I think also that Mr. Dickie is right in his criticism that to use steam pumps and fire pumps for drainage purposes is not desirable. After all, pumps of a capacity of fifty tons per hour, or, as in the English service, one hundred tons per hour, are very small compared with the capacity of the circulating pump which goes to several thousand tons per hour. Therefore, I think that if pumps shall be connected to the main drain besides the circulating pumps, they ought to be very powerful pumps, at least some 500 tons per hour. That is done in the French service, for instance in the *Suffren*, battleship, where the main drain is provided with four such centrifugal pumps of 1,000 tons per hour each, and is besides connected with the circulating pump of the central engine.

As to ventilation, Mr. Taylor has already spoken so fully on that that I shall not say anything more about it, except that I think that one feature is very undesirable in his proposal; that is, that the armor deck has to be pierced in so many places with his system.

The system of boats, and stowage, and handling of boats proposed by Mr. Dickie, I think is likely to be quite heavy and cumbersome, and I think that something lighter and more simple must be devised than the English system, where they use the mast, and they have large booms, one on the main mast, and generally two on the fore mast, and they have each of them a couple of windlasses. These booms are also used for the coal handling. Each of the booms can carry a Temperley transporter in large ships, some 55 feet long, and I think that is the simplest and readiest system that can be devised for boat handling.

As to the reintroduction of Scotch boilers, I will only mention that the latest reports from the war in the east point to the fact that the cylindrical boilers have consantly given trouble. The ships of the Japanese navy with cylindrical boilers have had to go quite frequently into port, whereas all the ships fitted with Belleville boilers have given no trouble whatever. The Russian cruiser *Pallada* was struck by a torpedo right inside one of her groups of Belleville generators, whereby the tubes were torn out and bent S-shape. The tubes were taken out, straightened and replaced, mostly by the ship's own engineers.

I think we must all be grateful to Mr. Dickie for bringing these important questions up for discussion. No time could be more opportune for it than the present, and although I do not agree with the author of the paper in all his proposals, I certainly agree with him in a general way in his endeavor to simplify the design of war ships.

Mr. F. D. Herbert: In looking over this paper I have been much impressed with the simplicity suggested in new design. There is one feature, however, I would like to be informed on, and that is how the central passage is entered through the protective deck. The long, central passage is inaccessible except at the very forward end, so far as I can judge from the paper.

MR. TAYLOR: It is stated in the paper on page 4, "Between frames 11 and 12 a vertical trunk 3 feet by 2 feet 6 inches, having an air lock entrance from the gun deck, affords means of access to the central passage."

MR. HERBERT: It appears to me that it is not practical, if the only method of gaining access to this passage is at one end of the ship.

MR. J. R ANDREWS: I would not presume to discuss many of these points with men of Mr. Dickie's ability, but on pages 14 and 15, regarding the steering gear and windlasses, he states that the windlass can just as well be operated electrically as a boat crane. Now, I think Mr. Dickie has lost sight of the fact that with a boat crane the maximum load is constant, while in the case of a windlass the maximum load is limited only by the breaking strength of the chain. Now, the two conditions are entirely different to my mind. I think that possibly the time may come very soon when electrical power can be used for operating steering gear and windlass gear. I think as regards steering gear the time has practically arrived. We have furnished a steering gear for one important ship, which was made on the Brown patent, with electric motors for driving, which I understand has been very satisfactory. On this particular ship there is no auxiliary steam gear attached, and so far as I know there has been no trouble with the electrical gear.

On the windlass question, I think that the Navy Department would welcome the time when the electric question can be solved satisfactorily as regards the windlass, and it certainly overcomes some very serious objections in the matter of running steam pipes. But up to the present time I do not consider that it is safe to discard the steam power for that particular machine. I should like very much to get the views of others on this point, because it is something that I am especially interested in.

MR. KELLOGG: I have had some talks in years past with Mr. Andrews on the subject of electricity for the windlass. We have always felt that the most desirable point to start an electrical plant on shipboard is practically the steering gear windlass. Those have been left for the last, principally, I believe, because they require a great deal of power and the central station has not been of sufficient capacity to take care of these in emergencies. But I think that all naval ships now have the power, and it should be used for either or both of those purposes at any time, and the question of having power can be taken care of in electrical appliances just as well as it can be in a steam appliance, and we stand ready at any time to furnish apparatus. I represent the General Electric Company. We stand ready to furnish apparatus that will take care of this particular appliance.

Mr. Dickie takes up the question of the power in the central plant. I do not feel that he has allowed anywhere near enough power for operating the appliances on shipboard. He has not allowed nearly enough for the ammunition hoists. I think that the power that he gives there would be required by those alone without any other appliances. He has not made any allowance for those or for air compressors, which I think are required now, or torpedo tubes. He has made no allowance that I can see for any form of operating gear for his torpedoes. The requirements of the plants have usually been larger than was contemplated at the time everything would be fully loaded. I do not think there is any great difference between a motor standing still or operating. Probably it would be in a little better condition if it were operating all the time than if it was standing still a good portion of the time. I have been for a long time advocating much simpler methods of installation of the electric wires on shipboard. It seems to me that we are using altogether too much pipe to lead conductors. There was one plant, on the *Kearsarge* and *Kentucky,* that was put in with the main leads simply insulated with ordinary methods or with heavy windings of jute and cord on the outside—braid—and lead in insulators all exposed along the wing passages. I have never heard of any trouble with those conductors, and the installation as a whole is very much lighter and is fully as reliable as any that has been made since in this particular. To-day the tendency is to lead everything in the pipes. I think that in all mains this could be done away with without any detriment to the ship.

MR. ANDREWS: I should be very glad if Mr. Kellogg would tell us a little more definitely just how he would arrange these things so that it would be perfectly safe to use electricity for purposes where the maximum load is not absolutely fixed, as in the case of a boat crane, or an ordinary winch. With windlass or boat cranes I should never consider using anything but electric power with the drive; but we furnished some capstans for the Russian battleship and cruiser built at Cramps' some time ago, and the great difficulty which was found there was not the fact that there was not sufficient power to drive them; the electrical appliances worked perfectly so far as they went, the capstans worked perfectly; but the trouble was when they got a line on the dock hauling the ship, the operator or the man who was handling the line could not feel his load. The result was that when he got a strain suddenly the motor simply kept going and parted the line. The same thing applies in the windlass. I think it is the earnest desire of the Navy Department to use electric power for this purpose, but up to the present time no sufficient guarantee has ever been given that anybody would build the electrical end to meet the exact situation which has got to be met in this case. I can say further that if anybody can meet this condition we shall be very glad to purchase something of the kind and put it in.

MR. KELLOGG: I can very quickly tell one method which could be used. The cylinders on the engines that would be used for the windlass might be the same proportion as the cylinders of the engine driving the generator. Therefore you could not very well overload the windlass without slowing down the engine. For the purpose of experiment in connection with one merchant ship, we used the electric machine driving that way and connected to the motor, and absolutely stalled the motor and had it respond absolutely with the load it was raising and lowering. The current used was not so great as to endanger the motor or the generator at all. Another way, which is the same we have applied recently in connection with a motor for a water-

tight door, is to make a high resistance either in the armature or circuit which will limit the flow of the current—not have any circuit breakers or anything of that kind in it. Then the response is immediate; if the load is released it takes up exactly the same as a steam engine. As it is brought on the motor can be stalled without any injury to itself or to any of the apparatus.

Mr. J. G. Winship: I notice an item in Mr. Dickie's paper on feed-water heaters. I do not think that the experience of the user of feed-water heaters in modern vessels would back up Mr. Dickie's opinion. It seems to be the idea now, in most all of the merchant service anyway, that the feed-water heater is a very necessary connection with running steam engines. I refer to the remarks on page 18. I have found that the advantage of a feed-water heater in connection with marine engines is that you can keep the temperature of the feed-water up to over 200 degrees, thereby keeping the boiler tighter, as they say; and another thing, you can carry higher vacuum on the engine and get better results all around by the use of the feed-water heater. As to the kind of a feed-water heater—that is another thing.

Mr. J. C. Kafer: There are many things mentioned in this paper that might be changed. But there is one thing that has not been mentioned. I think in a naval vessel, if they threw off every bath tub in the ship they would save a lot of space for other purposes. I have been at sea, and scraped off pretty clean after being dirty, without a bath, just with four tin boxes put together, and you can take a bath in that way just as well as in a bath tub. That is a very importnt item which I think ought to be brought forward.

Mr. Ferguson: Mr. President, I think the last speaker has brought up an idea which is really at the root of the simplification of war ship design. The proper way of simplifying a war ship is to simplify the requirements. If you are going to have long-arm doors, or doors operated from a distance, it really does not make very much difference whether you use Mr. Dickie's system or any other system; it is going to be complicated. If you do what can be done under some of the most recent designs, if you could leave out the doors altogether, you have a better ship, both so far as simplicity and safety are concerned. Mr. Dickie has simplified very much by doing away with the requirements of people who design ships, which was brought out very strongly by Captain Hovgaard; that is, he has simplified by virtually destroying his transverse watertight subdivision, which is probably the most important feature in a ship after the general requirements are once set and the characteristics determined. He has done away with it absolutely; even ventilation and other systems are to work with the valves open, and we all know that a valve or a hole in a bulkhead is generally, after years of service, equivalent to a hole without the method of closing it; that the only way to make a bulkhead tight is not to put a hole in it. Now, the idea, as I understand it, of the present system of ventilation is to ventilate a compartment from the top, which is, so far as the safety of the ship is concerned, the only way to do it, because otherwise you must have valves which are open, or automatic valves which do not work.

I think in regard to his boat stowage and handling scheme and drainage, he is doing what is done by most simplifiers of war ship design; he is proposing to substitute a scheme of his own for some one else's scheme, and that is what simplification generally reduces itself to by most people who propose it. Boat stowage could be simplified enormously by leaving off a great number of boats, which is done actually in time of war, and which will probably be done to meet the requirements of new arrangement of batteries sometime.

The electric power he has, as Mr. Kellogg pointed out, increased considerably, at the same time reducing his main generating plant. Either he has no margin or has not allowed enough power. In the case of the turret turning motors and ammunition hoist motors, the power that he has allowed is entirely inadequate.

As to leaving out voice pipes and omitting other fittings, I think that he has the sympathy of every one who has to deal with these things. But I am firmly convinced that the proper way to really simplify is to simplify the requirements, not only of the people who go to sea, but of the people who build and design ships. If they do not take some chances ships are going to be complicated, and war ships are going to be extremely complicated. It is just a question of putting in one man's device instead of another's.

THE SEMI-GLOBULAR NAVAL BATTERY.

BY ANSON PHELPS STOKES, ESQ., ASSOCIATE MEMBER.

ABSTRACT.

This paper is a description of a new type of floating battery patented by the author, and somewhat similar to other designs of floating battery. The plans call for a semi-globular vessel, 180 feet in diameter, 36 feet draft, and 24,650 tons displacement. The hull is built of steel throughout and the sides are heavily armored. The thickest armor is at the water line, 24 inches maximum, while the top sides are 15 inches, and the turrets the same thickness. The bottom of the hull is supplied with 1-inch armor. The armament consists of six 12-inch guns mounted in pairs in turrets; two 15-inch guns; eight 6-inch guns, besides smaller rapid-fire guns which, it must be admitted, is a light battery for so great a displacement.

The hull is subdivided by decks and bulkheads into a great number of water-tight compartments, while the entire superstructure is separated into three equal segments by three radial bulkheads. Each one of these has its own boilers and machinery, with the idea of making each independent of the other in case of accident. There are in all four engines, one in each of the forward segments and two in the after segment. Calculations and drawings have been carried out in considerable detail, and it is claimed by the author that such a floating battery is practically impregnable, and is indispensable in successful defence of our coast ports and of the Caribbean sea, now such a strategic point owing to the building of the Panama canal.

DISCUSSION.

Commander W. Hovgaard: Some thirty years ago, or perhaps more, that same proposition was made in Denmark. It was then proposed to build what were called floating forts—essentially the same as this—to be

used for the defense of Copenhagen. The matter was very carefully gone into at that time by the Danish government, and, after consideration, it was found preferable to build a fort on shore, and the front of Copenhagen being very extensive it was found necessary even to construct a small island on the shoal outside of Copenhagen, in 24 feet of water, on which a fort was built which is there now, and armed with, I believe, 14-inch guns, a very powerful battery. That fort cost altogether a little over two millions of dollars, and carried a great number of 14-inch guns, and, of course, a secondary battery besides.

The reason why the Danish government adopted that course, and did not go in for the floating batteries, I think, was the same that had made the Russians abandon the *Poprovsk,* namely, that such batteries, of course, however strongly you armor them and however carefully you subdivide them, are always ultimately liable to destruction by torpedoes and mines—possibly by ramming. Moreover, it was found that the *Poprovsk* steered very badly. Going up stream it would steer very fairly well. Going down stream it would be entirely unmanageable. Also, the propulsive coefficient being very low, it was impossible to obtain any considerable speed without a very undue expenditure of power. The great size, I am afraid, will cause difficulty in itself, because you must have docks to take the ships into, and I think that would be a very serious problem, to construct docks with nearly 200 feet gate entrance and 30 feet depth. They would, at any rate, be exceedingly expensive.

Turning the guns by turning the whole ship I think is likely to prove very unsatisfactory, in a ship that is so unmanageable as a circular ship is bound to be. The slightest lack of symmetry in the propulsive forces will send the ship turning round and round, and with the tremendous moment of inertia it is likely that it will be extremely difficult to stop her again—at least at any desired point.

COLONEL EDWIN A. STEVENS: Mr. President, it is rather curious that the first reported experiments against armor were made with the view of determining the availability of a battery very much similar to this one, during the war of 1812. Of course the thing was a very crude idea compared with Mr. Stokes' suggestion. The battery, of course, never was built—I don't know whether it even progressed as far as the design. She was to be anchored similarly to this one from the center, either by a mushroom anchor or by a spud, and was to rotate by screws, and fire her guns as they came around.

The same objection that Captain Hovgaard has raised as to the training of the guns on account of the instability of steering was raised during the war to the gunboat *Naugatuck,* which carried a 100-pound Parrot rifle absolutely fixed. The objection made by all naval officers was that it was absolutely impossible to hit anything with her. As a matter of fact, she turned out to be the most accurate shooting boat in the United States navy at the time.

I have always had a fancy for floating batteries. Small, ironclad vessels were used, I think, at the siege of Gibraltar, in 1804 or 1807. They were certainly also used by the French in the Crimean war. It would, of course, be impossible to drive any such design as this at any high speed, but it does seem that when we have just sacrificed speed so that a vessel cannot manœuvre in squadron, it cannot run away or overtake other vessels, it makes very little difference whether you have a little more speed or not. In other words, if we compare the usefulness of a design of this kind with the usefulness of our monitors, we have got a collection of vessels of that type which cannot run away from anything nor catch anything that merits the name of a war ship, and that cost money, and which, I believe, will generally be conceded are not a match for any vessel carrying anything like their main battery. The question is whether a floating fort, impregnable so far as artillery is concerned, would not be a better investment of our money than we have in the monitors.

THE SEA-GOING BATTLESHIP.

BY COMMANDER WILLIAM HOVGAARD, ROYAL DANISH NAVY, MEMBER.

ABSTRACT.

This paper is probably the most comprehensive treatise of a battleship that has ever been published, and embodies the design of a type of sea-going battleship to meet the present-day requirements. The fundamental elements of design, speed, armament, and radius of action are shown to depend on the work which the ship has to do. These elements being chosen, it is shown how the other elements—nautical qualities and protection—follow as a logical consequence. When considered from this point of view, the type of battleship will not suffer the variations in the building programme of successive administrations, but will indicate the true direction in which progress must follow. In this treatise the author is guided largely by the experience of the Russo-Japanese war and by the average conditions which the battleship must be prepared to encounter. The value of the claims of seaworthiness, armament, protection, speed, and endurance must be based upon the success with which they are worked into a harmonious design. By analyzing the present conditions, the author is able to make several deductions for his type of ship, and, at the end, he evolves a design somewhat similar to the *Connecticut* and *King Edward* classes. He states that while modifications proposed are of great importance, yet they are stepwise in character, and follow as a natural consequence of recent changes in the means and methods of war. The principal points are:

"Complete substitution of semi-heavy guns for the quick firers of secondary batteries, and consequent installation of all secondary guns in turrets, preferably twin turrets, placed on main deck. Greater subdivision of engine power by triple screws. Use of oil fuel by mixed combustion. Greater metacentric height and hence somewhat greater beam. Abandonment of center line bulkhead except where necessary between engine rooms. Both inner bottom and wing passage bulkhead to be fitted along the sides. Greater distance of lateral bulkheads from side. Wing spaces arranged as compensating tanks for righting the ship. Side armor to maintain midship thickness and height to extreme end of magazines, where the transverse armor

bulkheads should be placed. Lighter protection of barbettes below main deck. Only one armor deck.

"We have arrived at the proposed type on basis of specified conditions. It has been shown how the qualities required to meet these conditions are interdependent, and how, therefore, only one solution can be the best, namely, that which is consistent with the organic relations existing between the different elements of the design. In the battleship so designed we may say that the qualities are harmoniously balanced, since no one is unduly favored at the expense of the others, and each is present in a sufficient measure. This solution has necessitated a displacement equal to that of the largest battleship now building. As shown in the paper, this is due to the fact that the large ship, apart from its superiority due to higher speed, greater gun power, and better protection, is inherently superior to the smaller in point of nautical qualities, water-tight subdivision, economy of propulsion, and relative sea speed. These qualities cannot be attained in the same measure in a smaller ship, and, since they are not subject to addition, they cannot be compensated for by a greater number of units. The deficiencies will be greater the smaller the ship."

As a result of recent developments, the author admits that the use of sea-going battleships is limited and that there is an increased necessity for the construction of special artillery vessels for coast war.

DISCUSSION.

Mr. Forbes: I would like to ask the captain a question. On page 21 he says: "We may reckon the relative importance of the guns to be proportional to their penetrative power." In all battleships the chase of the turret guns is very much exposed. I would like to ask the captain if the fact of the area being so small is its great protection?

Commander Hovgaard: No. I simply argue that the protection should be proportional to the importance of the guns, and I measure the importance of the guns by the penetrative power and by the arc of fire of the guns. Now, the arc of fire of the broadside turret guns must be considerably less than that of the heavy guns placed at the ends. They have 270 degrees of arc of fire, while those of the port side would hardly be able to get more than 180 as a maximum. Therefore, taking that as a consideration, I argue that the greater rapidity of fire of the smaller guns is balanced by the smaller arc of fire, and therefore on the whole that the importance of the guns becomes proportionally higher with their penetrative power, and therefore they should be protected on the basis of their penetrative power simply. I have not considered the other question of the protection of the chase of the gun.

Mr. Forbes: Another thing is the location of the conning tower. There is nothing said about that in this paper, but I notice it must be very heavily protected. I saw particularly a ship not long ago where the conning tower is so placed that to me—not being a practical nautical man—it seemed impossible to manage the ship under any condition, unless you are fighting head on. It seems to me that if the conning tower is as heavy as the captain suggests, it would be put above everything, and should be so placed.

Commander Hovgaard: As regards the location of the conning tower, I have not thought to suggest any other location of the conning tower than is usual in the modern battleship. I think it is almost impossible to make any change in that.

Naval Constructor Joseph H. Linnard: Although I have not had an opportunity to examine this paper in advance of the meeting, it appears to be a very carefully considered and compendious statement of the problems that are involved in the design of a battleship. We have had a paper showing the desirability of simplifying ships, particularly men-of-war, and this presents to us some of the reasons why complications are necessarily involved to obtain the requirements that modern conditions of sea warfare demand, and the paper states so clearly the various conditions that must be set off, the one against the other, and the different reasons which lead to balancing one quality against another, that it seems difficult to make any remarks that would not be more or less a reiteration of the statements in the paper. But it is one that certainly will lead any of us to give more thought to the problems that are placed before us in these questions stated.

Rear-Admiral George W. Melville: Mr. President, I am very much pleased to see that our society is honored with a paper from Captain Hovgaard in regard to designs of battleships. I am pleased to say that I see nothing at all in it to condemn, much to commend, and very little to criticise. Among other things I am pleased to say, as ex-engineer-in-chief of the navy, among the hard hitters of the triple-screw system of battleships, that I at least have his backing on the subject.

The President: Are there any further remarks? If not, the chair feels justified in saying that this paper will bear undoubtedly thorough and careful study, and it must be gratifying to every one who has been engaged in the design of war vessels to have such a thorough and logical treatment of the subject as this, producing results which to a very slight extent modify the prevailing types. There are no doubt points of gratification in this paper to our vice-president, Admiral Melville, and there are undoubtedly to others. One especially satisfactory to me is the fact that the second armor deck, a feature of the British navy, has been omitted, and it may be right to remark that the omission of the second armor deck in our battleships has been the most important means of giving us an advantage in offensive power.

SECOND SESSION.

The second session was called to order on Thursday afternoon at 2:20 with the president in the chair.

SOME RECENT EXPERIMENTS AT THE U. S. MODEL BASIN.

BY D. W. TAYLOR, NAVAL CONSTRUCTOR, U. S. N., MEMBER OF COUNCIL.

ABSTRACT.

This paper gives the result of experiments which have been carried on at the United States experimental model basin for determining the power and efficiency of model propellers of the ordinary three-blade type, throughout the range of pitch ratio and blade area

regularly to be encountered in practice. The experiments covered thirty model propellers varying from the low pitch ratio of .4 to 1.5, and for each pitch five propellers with different widths of blade were used. As a result of these experiments a new propeller formula has been evolved.

Where S is a power coefficient derived from the author's experiments, P denotes the horse power absorbed by the propeller, d the diameter in feet, and V the speed of advance of the propeller in knots.

Then, $P = .0093648\ Sd^2\ V^3$.

The probable effect that the back surface of the blade has upon the true pitch is indicated in the propellers of narrow blades. The most unusual feature of the results is the disclosure of the fact that as the pitch ratio is decreased the influence of the area of blade upon the results also decreases until for propellers of very fine pitch the narrow blades actually absorb greater power. It is also shown that the maximum efficiency of a propeller may reach as high as 79 per cent., which is about 10 per cent. higher than formerly believed possible. Accompanying the paper are several figures illustrating the form of blades used and plotting the results of the trials. It is, indeed, one of the most valuable contributions on propeller data that have been contributed, and ranks on a par with Froude's and Durand's experiments.

DISCUSSION.

COMMANDER WILLIAM HOVGAARD: I think the society must be very grateful for the extremely valuable information which has been given to the transactions through this paper.

Mr. Taylor remarks that the efficiency falls off very much at the lower pitch ratios. That is, in fact, seen from the curves. I think that is a fact which has great interest with turbine propulsion. The fact is that the turbines have their greatest efficiency at a very high speed, and very high speed of revolutions means always a low pitch, a feature of which becomes greater the lower the speed is. It is mainly desirable to work with a certain slip, or at least not to fall below a certain minimum slip. Therefore, if the number of revolutions is high the pitch must be small. On the other hand, also, the diameter is limited with regard to cavitation. We cannot go below a certain area of the propellers, and therefore we have to do one of two things: either we have to split up the power in a great number of propellers, as is done in some ships, and that is undesirable and has proved to be not very efficient; or else we have to accept a very low pitch ratio, which we have now seen is also inefficient; and therefore since this objection is greater the lower the speed is, it seems that there must for every type of turbine be a certain speed below which it does not pay to use the turbine instead of the reciprocating engine. I think it is an understood fact that we must expect for every type of turbine to limit it to the speed at which it will be advantageous to use the turbine as a means of propulsion. This fact was pointed out by Prof Latrobe last spring, at the meeting of the Institution of Naval Architects in London, but it is corroborated here by the experiments which Mr. Taylor has laid before us.

COLONEL EDWIN A. STEVENS: It is of course impossible to digest the matter submitted by Constructor Taylor in this paper in even a period of many days—certainly not in the time this paper has been in my hands. I am only struck with the immensity of the ground he has covered, and at the fact that he has been able to accomplish what he has done at all. When we consider the ground covered by the experiments—the fact that Froude's, really the classical experiments, included practically three-bladed propellers and any one series of two and four blades, and in those the only variable was the pitch, and that Prof. Durand's experiments included a blade of constant pitch but variable in area—and when we consider that Mr. Taylor has varied both the area and the pitch in his experiments, the amount of ground covered becomes very evident, and that great care must be necessary in summarizing the results is also very evident.

I have recently had occasion to want to determine, pretty accurately, the performance of propellers, and in employing different formulæ to check the work I came across a result similar to the one given by Mr. Taylor; that is to say, that under the conditions existing in that case, not only the thrust but the power absorbed by a wider blade would theoretically appear to be less than with a narrow blade. Mr. Taylor makes it less on slip in this case. I am plotting on the area of the blade. It would appear to be theoretically indicated that such is the case. Practically in my experience I have had a similar case, but it arose in a full-sized vessel and without the accurate measurements which were necessary to determine such data with scientific accuracy, I could only give it as a general tendency. In that case there was the four-bladed propeller not working as efficiently as was hoped for. It was thought then that a better solution might be reached by substituting three blades of practically the same helicoidal surface as the original four blades, trying the propeller under these conditions. This was done, and the power absorbed by the larger three blades was practically the same and the thrust slightly less than with the four blades.

I see that in the appendix Constructor Taylor has gone back to his formula and substituted for the $S\ V^3$ which he expresses to-day, making the formulæ practically the same, excepting that S is drawn from curve instead of being drawn by calculation from the outline of the wheel. I have used that formula, and generally with good results. It has always seemed to me that the sensible way of getting at a propeller was that, as soon as the first elements of your ship were fixed, you had a general idea of your displacement, a general idea of the power necessary to attain the desired speed, you should begin at the other end, determine the resistance of your ship and the thrust necessary to overcome that resistance, and then design your propeller to give that thrust, and simply rest your design on that, of course with such modifications as are always coming in, in tentative first arrangements. In other words, it seems to me we more often run into trouble with our propellers from insufficient allowances, from diameter or for speed in revolution, than we do with almost any other one single item of design, and that it is a point at which the economy can be secured with less expenditure than almost any other. In other words, we make a mistake

in our propeller and then try to remedy it in very costly arrangements with the engines or with an expensive inefficient plant.

Naval Constructor Joseph H. Linnard: Mr. President, I have had the pleasure of seeing a few of the runs made in the model basin with these propellers, and one of the reasons that I went down to see them was that I wanted to get what cavitation looks like when you have it, for we have heard a great deal in recent years about cavitation and the disastrous effects it produces on efficiency of propulsion. I had had rather the impression that when cavitation occurred the water was sucked down from the surface to a certain extent, owing to the lack of pressure at the back of the blades. But in actually running a propeller in the model basin that is cavitating nothing of the sort occurs. The water in the basin is very clear, and you can see the propeller perfectly well until the speed of rotation becomes so high that it turns into a disc. But when running at ordinary speed, at which the cavitation does not occur, you can see this bronze rotating with the light reflected from the blades, and the water remains perfectly clear and the surface of the water in the basin is practically undisturbed over the propeller.

As the speed increases the propeller develops gradually a slight haze behind it. The water, instead of being perfectly clear as before, becomes slightly clouded, and as the speed goes up higher it becomes noticeably clouded, and the propeller itself is followed by a long cylinder of cloudy water which has precisely the same appearance as if there was a sight infusion of milk following the blade. It apparently is practically cylindrical. The facilities were not such that we could look at the front of the blades. But at the same time, when this cloudy appearance occurred, the water still remained on the surface as absolutely undisturbed as it was before, and apparently the surface disturbance was *nil,* although the appearance associated with cavitation and as shown at the front curves was in strong evidence. The interesting thing to me is how this cloudiness appeared, and there would seem to be only one explanation for it; that is to say, on the theory that Mr. Taylor announces that the cavitation is due to the parting of the water and its failure to immediately close, creating a vacuum. The contained gases in the water are liberated to a certain extent and flow behind with the blade, producing a sort of gaseous condition, like air being released in the water and not immediately absorbed again, and this appearance seems to confirm Mr. Taylor's opinion of the real cause of cavitation. Mr. Taylor tells me that he hopes to go on with the experiments with four-bladed propellers, and until he has done so he does not desire to announce any general theory; but, like all experimenters that go into their work without prejudice, he tells me that some of his preconceived theories, which he has already announced, have been very rudely disturbed, and I hope, therefore, that at a future date he will be able to give us a more thorough discussion of the general aspect of the question as disclosed by the experiments and treated with the mathematical ability which we all know he possesses.

One thing that struck me as the experiments went on is particularly disclosed in reference to those propellers No. 23 and 23A and B, and that is the influence of the back of the blades. It would seem that most of us in considering propellers give all our attention to the driving surface of the blade, with the idea that that is doing the work and the back of the blade is rather left to take care of itself. When we determine the thicknesses from experiment and theory that we think are necessary to give the necessary resistance to the blade so that it will stand up to its work, that is all that is necessary, and the general shape of the back of the blade seems to take care of itself to a great extent with those limitations. But these experiments seem clearly to indicate that in designing it will be as necessary to consider carefully the shape of the back of the blade as the shape of the front of it.

The President: Are there any further remarks upon this paper? If not I will ask Mr. Taylor to make such remarks in reply as he desires. While it may not be desirable to press him to give us an outline of his further work that he has in mind, I have no doubt it will be interesting.

Naval Constructor D. W. Taylor: Mr. President and Gentlemen: With reference to Commander Hovgaard's remarks, Commander Hovgaard pointed out very truly that these experiments show a falling off in efficiency as the pitch ratio is decreased. I might point out, however, that that is associated with propellers which are all of the conventional shape of blades, a helicoidal driving face and a convex back, practically the arc of a circle. I am inclined to think that some of this falling off in efficiency could be prevented as the pitch is decreased by suitably modifying the shape of the back of the blade. The experiments with 23A and 23B indicate that something could be done along that line, and I hope to make further experiments before long with four-bladed propellers, and in the series I expect to introduce a few modifications in that direction to test what could be done.

Mr. Forbes: Do you mean flattening or increasing the arc?

Naval Constructor Taylor: I would anticipate that if I flattened it we would get better results. Propeller 23B, which shows low efficiency, was a very extreme change; but you will note that at the low slips the efficiency was higher than the others, and I expect that if the change had been such that it was accommodated to a 15 or 20 per cent. slip, the efficiency could have been brought back to fully what the other shows, retaining the very desirable feature of high value of S coefficient. This high value of S coefficient, as I pointed out before, enables the propeller to be made smaller, which is necessary when the pitch is small, as it must be with quick running engines, to keep the diameter down as small as possible. I think, perhaps, that with a man-of-war there may be something gained with the quick running propellers by making them four-bladed instead of three-bladed, but that is a matter that can really be settled only by experiment.

Relative to Colonel Stevens' remarks, I might say I point out in the paper that the first regular test of a model propeller was made in August last. Of course we had been preparing apparatus for some time and making tests in order to get the experimenters drilled,

so that we could finish them rapidly. We cannot give very much time to this work; it is something of a side issue for the model basin, and it was necessary after we got propellers made to get rid of them as soon as possible. When we were well under way we ran two model propellers a day, one in the morning and one in the afternoon, completing the experiments. We generally ran at 4, 5, 6, and 7 knots' speed of advance of the carriage, and at each speed of advance of the carriage would make 6 to 8 runs of the propeller at various slips so as to cover the range. The fact that Colonel Stevens has brought out with regard to actual full-sized propellers is very interesting, and confirms to some extent the results reached with the experiments with the models. As I point out, it is necessary to be cautious, and not to apply these results to full-size propellers until they are actually confirmed by experiment. But that is very difficult, and every piece of evidence which indirectly confirms the accuracy of the model results as applying to a full-sized propeller is of value.

I might add to Mr. Linnard's statements about the cavitation—he brought out the fact that the water was undisurbed. But it is mentioned in the paper that the propellers were placed their own diameter below the water. The center of the propeller in each case was sixteen inches below the surface for the regular runs. The run on which he saw cavitation was made while the basin was being filled up after it had been pumped out a little, and I think at that time there were only about 4 inches of water over the top of the blades, only half of what was present during the ordinary run. It may have been even less than four inches; but even at that speed there was no disturbance at the surface of the water immediately over the propeller and for several feet behind it.

The President: I would suggest, Mr. Taylor, that if you have in mind any comparisons between model propellers and actual propellers, that the general subject of such comparisons might be outlined with a view to assisting in obtaining such results.

Naval Constructor Taylor: I do not think, Mr. President, that I am prepared to outline that at this time, because the problem is very much complicated as regards a full-size ship by the question of wake and thrust friction. The propeller attached to a ship, instead of working in undisturbed water, is working in water which is very seriously disturbed, and it is not only driving the ship ahead, but it is sucking up water, and that introduced a number of complications which will make it quite a serious undertaking. If we knew in the case of a full-sized ship the exact wake and the exact thrust friction, why then we could try various full-sized propellers, and determine the speed and have the results analyzed, trying also the models of those propellers. We have under design apparatus for investigating the wake of the models, and I hope in a few months more to be able to determine that wake with fair accuracy as regards the models.

There will be necessarily some slight uncertainty as to whether the wake of the model is exactly the same as that of the ship; that is, with 10 per cent. wake of model whether the ship will also show a 10 per cent. wake. But there is one thing in these trial results, and which is very obvious from watching the run of the models, that this wake for a given ship is not a constant. It is generally assumed to be constant for the purpose of design, but if you watch the model under way you will see that above the propeller at one time there is a wave crest, and at another time there is a wave hollow, and it is a physical impossibility but that when the wave crest is there the wake is necessarily greater than when the hollow is there. The part of the wake due to the frictional drag of the vessel dragging the water along with it is probably not seriously affected by the speed. But the part of the wake which is due to the wave action is undoubtedly affected by the speed, and I think you will find in Mr. Powell's paper, which will be read to-morrow, analyzing the curve of efficiency of propulsion, the variation in that efficiency, which I ascribe primarily to variation of wake, we have found in analyzing progressive trial results a similar tendency in nearly every case. It generally occurs at the speed of ships corresponding to a speed of model a little under 4 knots. It appears that at that speed there would be a tendency for the wake to decrease. As you increase the speed the wake appears to gather strength again.

The President: Gentlemen, in suggesting a vote of thanks to the distinguished author of this paper, the chair probably voices your sentiments in saying that it has no knowledge of any more valuable or useful paper ever having been brought before us, and also may remind you that these results, presented in such an apparently simple manner, are the result of some years of study which has proceeded continuously, but, as Mr. Taylor says, as a side issue of this more important work at the government experimental tank.

In the absence of the author the next paper was read by Mr. Cox.

SOME FURTHER NOTES ON THE PERFORMANCE OF THE TORPEDO VESSELS OF THE UNITED STATES NAVY AT SEA.

by Lieut. L. H. Chandler, U. S. N., Associate.

ABSTRACT.

This paper is a supplement to one presented by the author before the society at its last meeting, and contains the data obtained from the flotilla of torpedo boats which crossed the ocean to the Philippines and those which have seen sea service along our coasts. The author states that while the greatest rolling recorded was 35 degrees, on the *Decatur,* in moderate weather, there is no accumulated rolling, so to speak, and that there rarely are more than three or four heavy rolls together; none of the serious wallowing was noticed. Further the author states that there were but a dozen times in his two years' experience on this vessel in which it was too rough to set the dining room table. The rolling and pitching in the Asiatic flotilla never caused any serious trouble to machinery, although it was necessary to handle the engines carefully when in heavy weather. In criticising the type of vessels, the author suggests that future boats should have a less ratio of length to beam, even at the expense of speed in smooth water; that coamings 4 feet high should be about all important hatches; that the stern be

modified to decrease pounding and consequent shattering tendency of the hull. As the author has been conspicuously identified with the operation and manœuvring of United States torpedo boats, and has done much to bring this type into good repute, his remarks are of special value. The paper contains several tables of data of observations taken on torpedo vessels at sea, and there are several half-tones illustrating the close wedge formation when manœuvring.

DISCUSSION.

Commander William Hovgaard: In the fall of 1888 the Danish government fitted out three Thorneycroft, first-class torpedo boats, to compare their sea-going capabilities. One was very much stiffer than the others. The period of oscillation of the stiff boat was about 1 3-4 seconds for a single roll—consequently much stiffer than are the American destroyers. The other boats had a period of 2 1-4 to 2 1-2 seconds for a single roll. One of these last-named boats had a fin keel; the other boats had bilge keels. The fin keel was placed diametrically under the keel, and of a very large area, about 2 feet deep. The first of the boats tested was examined for a period of roll. The center of gravity and curves of stability were calculated; in fact, all that could be known about these boats was found out in the navy yard before they were sent out. In a cruise, that lasted about 3 weeks, we tried to get all the rough water and bad sea we could find in the Baltic and in the Categat.

We had battens for measuring the roll, and the rolling was measured systematically at different angles relative to the direction of the waves. We took it with the sea right ahead and four points on the bow, and so on throughout the whole circumference of the compass, and in that way we got a very complete series of results which we could compare, and it was found there that the boats of small stiffness would roll very badly. Sometimes when placed in a certain position to the sea, like the American boats here shown, they would take very excessive rolls at times; but it was curious that this was combined with a very small average medium roll, so that the boat that would take the greatest oscillation sometimes would be really the steadiest boat, the one that would have the smallest average of roll throughout the whole series of observations. The action of the fin keel, which was one of the most interesting points, was very marked, and that boat, which I happened to have command of, behaved decidedly much better than the others, and as found by Lieutenant Chandler, the worst rolling was generally experienced when the boats were going some three or four points from the wind. Then the action was strongest, and of course the momentum of the boat—the energy of the waves—was increased by the speed. We also found very considerable bending of the plates. We measured it up to 3-4 of an inch, even up to 1 inch, on one of the boats, but there was no sign of weakness. It was all within the limits of elasticity. The Thorneycroft boats had the same peculiar flat sterns, and they would pound badly at times, but not so as to cause any anxiety for the strength of the boats. The results of those experiments were published in the London *Engineer,* in 1888.

Mr. Weatherbee: Mr. Chandler has probably done more than any one man in this country for some time in bringing the torpedo boats into better repute, so far as their sea-going quality is concerned. For boats to steam in the wedge formation 15 knots, with the bow of one touching the stern of another, in even the smoothest sea, looks off hand to be quite an undertaking; but he has done it successfully in many cases. There are two things that strike one in looking over this paper. Referring to Tables 1 and 3, it will be noted that the sea-going displacements given in Table 3 are very much in excess of those given for the trial displacement. I figure that in the case of one of the boats this would be about 2 feet greater immersion than the water line on which she floated on trial. This would represent a freeboard of only 3 feet. Now, I think it is remarkable that a boat would go to sea with such a low freeboard as that and with such a heavy overload, and still be apparently seaworthy. This has also been demonstrated by the destroyers in the fleet that went out to Asia, and data of this kind are certainly reassuring, because torpedo boats have been spoken of as being of very light construction and not sufficient strength to stand any sea-going work.

Mr. Magoun: It might be interesting to have some further information on the performance of some of the other boats, but I don't know that anybody can give it. I know I cannot myself. But I should like to point out that the boats referred to in this paper have an entirely different form of stern from certain other boats of the navy, and I should think that the effects Mr. Chandler speaks of would be much more marked with the hollow stern than in some of the other boats.

The President: The absence of Lieutenant Chandler is certainly to be regretted, but it is gratifying to all those who took part in the design and construction of these boats that the evident verdict from the reading of this paper is that they were all very good boats. In the absence of the author the next paper will be read by Mr. Cox.

THE U. S. ARMORED CRUISER COLORADO.

BY ASST. NAVAL CONSTRUCTOR, J. M. POWELL, U. S. N., ASSOCIATE MEMBER.

ABSTRACT.

This paper, as the name implies, is a description of the armored cruiser *Colorado,* the first of her class to run her trial, which took place successfully in October. That there are 142 electric motors of 850 horse power shows the extent to which electricity is used for auxiliary purposes. Comparison is made between the *Colorado,* the British cruiser *Drake,* and the French cruiser *Leon Gambetta.* In an appendix is given in detail the service tests required for the electric auxiliaries. The results of the preliminary builder's trial are plotted in curves on accompanying diagrams.

COALING WAR SHIPS AT SEA—RECENT DEVELOPMENTS.

BY SPENCER MILLER, ESQ., MEMBER.

ABSTRACT.

This paper is a description of the apparatus patented by the author for coaling war ships at sea, and is in the nature of an account of the several demonstrations, first by the British Admiralty, then by the Russian Ad-

miralty, and, finally, by the United States government, of the Lidgerwood apparatus. This system of coaling at sea has been considerably modified, until now the apparatus is carried entirely on board the battleship or cruiser, so that the war ship may coal at sea from any collier.

DISCUSSION.

ADMIRAL BOUTAKOFF: Unfortunately, although I have no reports from the Baltic fleet concerning coaling at sea, I wish to say a few words in reply to the criticism I have heard in this country of the lack of simplicity in the Lidgerwood-Miller apparatus for coaling at sea, and that the results were rather poor. Nothing appeals to the heart of a seaman as much as simplicity. We have a proverb in Russia saying that no man who has not been at sea has ever prayed God in earnest. That proverb has the meaning that nowhere the seriousness of things surrounding people is appreciated more than at sea, and of course the simpler the surroundings of a seaman the better they are under his control and the more he appreciates them; but of course simplicity has its limits. There were many simple things that have existed, but if they remained in the same state of simplicity no great achievements could have been made. Things may be very complicated, but if we are given the possibility of handling them simply (and seamen will always be glad to have that) I positively do not see any reason why the device of Mr. Spencer Miller could not be applied with profit on board vessels on the high seas. We all know of the American engineering—the fame of American engineering is far spread all over the world—and I positively do not see the reason why our navy and the fame of the American engineering could not profit by adopting the new device of Mr. Spencer Miller for his coaling apparatus.

THIRD SESSION

The Friday morning meeting was called to order at 10:45 with the president in the chair.

The first paper to be considered was, in the absence of the author, read by Mr. Macalpine.

TIME ALLOWANCE FOR STEAM YACHT RACES.

BY REAR ADMIRAL GEORGE W. MELVILLE, EX-ENGINEER-IN-CHIEF, U. S. NAVY, VICE-PRESIDENT.

ABSTRACT.

This paper contains a description of the rules drawn up by the author for determining time allowance for steam yacht races, especially the *Haouli* cup races. The intention has been to draw up a set of rules that will make the winning of the race depend upon the design and construction of the hull and machinery and the excellence of seamanship displayed. Hence the object of a time allowance is to annul only those advantages, arising purely from physical laws, as increased size in the proportions of the dimensions and of the power installed. The formulæ given depend only upon those measurements which can be made readily and with accuracy, and are: length of water line, greatest beam at or below the water line, mean draft, and grate surface. The formulæ are according to the laws of comparison, with certain modifications which, in the opinion of the author, should be introduced for the particular conditions met with.

DISCUSSION.

THE PRESIDENT: I would suggest that you tell us, Mr. Macalpine, what the rule as established is.

MR. MACALPINE: The rule is given on page 16, under the table giving the determination of constants; the last three lines give the three terms of the rule. The first term involves length and grate surface, discriminating as to whether there is forced or natural draft; the second term depends upon the breadth divided by the length; and the third term gives the time allowance.

Then there are various conditions; that is to say, three of the terms noted at the head of page 17 were to be considered zero if it turned out to be negative. That was to cut out excessive breadth; not what would usually be called excessive breadth, but those that had not very fine lines, as it would hardly be possible to make a rule such that a very full ship should be built to win a race. Then the steam jet in the funnel was not allowed, and no by-passes were allowed to be used in the engine. Forced draft in the stoke hold or ash pit was allowed, but not to exceed 2 inches of water.

Of course much had to be done by Admiral Melville in framing these rules to gain simplicity. The necessary assumptions in all cases, I think, were made with a view to come sufficiently near a true final result and still keep the rule very simple indeed.

MR. PARSONS: Mr. President, this is an admirable peper, and seems to be a very able enunciation of the principles involved in rating steam yachts for the purpose of racing. I notice that the admiral states that the deductions are not exact, nor are they intended to be exact. And for the purposes of racing steam yachts it is well that the rating should not be exact, because that would introduce so many complications as to render the result inapplicable to practical racing purposes. Last June the speaker had the pleasure of serving on a committee which raced two steam yachts 60 miles off Sandy Hook. The yachts raced on the outward leg 30 knots, and then turned the mark boat and raced back. By applying the data obtained from that race the formula deduced by the admiral gives a result which almost exactly corresponds to the difference in the time of the speed of the two yachts. One yacht beat the other by about 4 minutes, and the formula, upon the assumptions made, would give for the two yachts 4 1-10 minutes as the time allowance, which is, of course, extremely accurate.

In respect to racing steam yachts one should be careful to get up a formula which will prevent progress toward dangerous limits. The owners of steam yachts are frequently willing to spend plenty of money in order to obtain a purpose, with the result that the sport tends toward a dangerous limit. The rules should therefore be in the nature of extreme penalties for all cases where extreme results are desired. The chief factor, of course, is the horse power, and the effort in building a racing yacht is to float the greatest power that is possible, with the result that freak designs are produced. If we could determine the horse power it would not be difficult to get up a satisfactory and simple rule for racing yachts. But the trouble is the difficulty in obtaining that horse power when the yachts are of small dimensions. Even

in the larger yachts it is difficult to get the indicated power of the engines, while with turbines it is impossible to obtain the indicated horse power. The effort has been in the past to determine the horse power as some factor either of the heating surface in the boiler or the grate surface. The speaker is pleased to note that the admiral has selected the grate surface. The heating surface does not appear to have any ratio—that is, any definite ratio—to the horse power generated, while the grate surface does bear some relation thereto. If the grate surface is too small to burn the coal or fuel the heating surface, even if it is excessive in amount, is of little value, while under the same conditions rating on the heating surface would give abnormally high value for horse power.

Unfortunately another trouble arises, that of burning liquid fuel, if we use the area of the grate as the standard dimension for determining the horse power. In rating an ordinary reciprocating engine on selecting a number of results that have been published it is found that the mean effective pressure referred to the low-pressure at the engine, and with a ratio of expansion theoretical mean effective pressure, the latter being taken as that due either to the boiler pressure or to the pressure at the engine, and with a raito of expansion equal to the volume of the low-pressure cylinder divided by 8-10 the volume of the high. That 8-10 allows for the slight cut-off in the high-pressure cylinder.

With regard to drafts the admiral named either the natural draft or a forced draft, and he limits the forced draft at 2 inches of water. From a number of records of torpedo boat destroyers it is seen that the pressure exceeds 2 inches by a very considerable amount. It runs up as high as 4 inches and over. It has gone considerably higher than that, but for economical reasons I understand that the higher limits have been barred by the Navy Department. With steam yachts there would be no such bar. A man would not hesitate to burn up his boilers in order to win a race. It does not seem fair, then, to limit the draft to 2 inches, and the speaker would suggest some other basis, say unity, and then some value for the constant (f) the admiral's formula for a jet draft, and some value for a blower draft with a closed stokehold or closed ash-pit system, and choosing those values for (f) as the maximum in either class, on the assumption that the owner during the short time the race is in operation will practically keep to the limit. The speaker would suggest a rating based entirely on the admiralty formula.

In order to prevent freak designs the speaker would divide up the classes so as to maintain yachts with approximately similar lengths and rating in one class together, and relegating any excess over the limits, maximum or minimum, to the class of a penalty charge deducted from the time allowance. Furthermore, a simple formula such as that just advocated as the basis of a rule would leave the yacht designer free, without any restrictions as to length, breadth, or draft.

Mr. W. P. Stephens: Mr. President: I am not prepared to discuss this paper on its intrinsic merits, but there are one or two points in connection with it that I desire to call attention to. The paper is most timely because there has been within the past year or two a distinct revival in the racing of power yachts. This is more marked in respect of the smaller yachts, but there have been several races run in past years with larger steam yachts, and what steam yacht racing may develop into depends upon whether such racing will ever be a regular form of sport. But there is just now an interest in it which is well worth cultivating by the larger yacht clubs.

In connection with the opening paragraph there occurs to my mind a previous attempt at steam-yacht racing, I think in 1884. The race was from New York to New London, and there were no less than five distinct systems of time allowance arranged for. Out of a dozen yachts entered almost everyone was running upon independent principles through the various time allowances. Now, there is a rule needed, I think, at the present time. It seems to me that the experience of sailing-yacht racing which is very potent, demonstrates the necessity of some recognition of displacement in any rule for steam-yacht racing. Of course a rule is important from two points of view. A racing rule for any class of yachts is used to measure existing yachts, and it may do that fairly well and act perfectly for a time, but it is worthless if we do not consider its effect on yachts to be built later. A rule may work very well for two or three years for a certain class of yachts, but as soon as some clever designer starts out to beat the rule he is almost certain to produce an undesirable type of freak.

The great lesson of late years has been the value of increasing displacement. I think the displacement of steam yachts now represents a pretty fair average of all around qualities, but if it becomes a question of building a big yacht the first thing the designer will do will be to cut his displacement; that is to say, his construction will suffer at once, and we shall obtain an undesirable type of boat in every way, lacking in accommodation, more or less weak, and lacking in durability. It seems to be absolutely essential therefore that the displacement or the midship section should find a place in the rule in order to guard against what we know is a danger in all classes of yachts.

Mr. A. A. Packard: Mr. President: Any rule that may apply to existing yachts is not necessarily a good rule. That point is brought out, perhaps, in this method of measuring grate surface. The direct draft, the natural draft, is not measured, so I should think the designer would be tempted to make an enormously high stack and a very large funnel, and so get practically a large forced draft without paying for it.

One way to measure the power would be to measure the coal. Let a certain yacht carry so much coal for a certain race. Another method is to measure merely the cylinder areas, assuming the best practice in pressure and piston speed as giving the horse power; that is, assuming that to be constant. This is a very simple thing to measure, and it works well in high-speed power boats. A third method would be to measure the propeller; that is, to allow a certain amount of horse power for a certain diameter of the propeller. Either one of those three methods would be very hard to get around and would give a simple measure of the boat's power.

The first speaker referred to the importance of a simple rule. That is very true. The admiralty coefficient applies excellently if you apply it to boats of the same length. Admiral Melville speaks of the humps

and hollows of the distance curve as not being very important, but in high-speed yachts it becomes very important, because you may take 1-3 more power for a boat of 10 or 12 feet shorter length. For this reason it is very important to class them to have yachts giving the same speed or the same corresponding speed in racing.

Colonel E. A. Stevens: Mr. President: The problem of arriving at a rule for placing two vessels which are essentially unequal upon an equality has always seemed to me one of the impossibilities. Years ago, when the question of time allowance for sailing vessels first received any scientific consideration in this country, it was deemed at the time that a solution could be reached by using the length and the square root of the sail area. The American system was to take the mean of the length and the square root of the area. The English method was that of taking a cube represented by the product of the length and the sail area. That was supposed to solve the difficulty. It was thought that we were going to have vessels normally planned, with a normal sail breadth, and with a maximum of accommodation and a minimum of sail area. The result proved to be far different. That is to say, when Mr. Burgess and Mr. Herreshoff and other gentlemen put their brains to work on the problem they beat the rule out of sight. And a like result must unquestionably follow if you take the very much more complex problem of placing steam vessels on an equality where you are going to attempt not only to tax the vessel for the opportunities the designer of the hull has had but also for the opportunities given to the engineer to create steam; and how any rule can avoid the production of freaks and racing machines is something that is entirely beyond my comprehension. That you can put the boats now built upon some fair basis of equality, some sporting basis if you will, is perfectly possible. I think certainly it can be done, and I have no doubt that Admiral Melville's solution will do it; that is, will give the majority of vessels now built a fair sporting chance, but that it will prevent the creation of racing machines seems to be too much to hope for.

If we are going into the question of racing it seems to me we shall have to come to what is the best sport. We shall have to make a class of vessels of practically identical designs, stipulating exactly what a man may use, and restricting him as against undesirable features and then allowing him to go ahead and produce a racing machine to that extent. We may go as far as to force a man to build a vessel from certain particular drawings, and with a certain particular size of cylinders with a particular stroke; and I suppose we shall go as far as to give him his propeller design. And then it will become a question for the engineer and the designer and the captain—the captain keeping his bottoms clean, and the steersman keeping his proper course. At the same time, given a set of arbitrary conditions in that way, you are going to make it possible for men to make race boats. But if you are going by the other scheme a class of boat is built to race this year, say; but next year, somebody, profiting by the experience of the past year, will build something which will make all the rest look silly; and those five or six boats will go into the junk heap as far as racing is concerned. It seems to me, therefore, that the policy of yacht clubs ought to be, if they are going to encourage steam yacht and power boat racing, to limit the classes closely, so that the designs will all be limited within very close limits, and will require merely the exercise of careful design and making the best out of conditions which in themselves would not admit of anything but one special type of vessels.

Mr. Macalpine: In reading through his paper you will notice that, as far as he thought he dared, the admiral has set his face determinedly against freak yachts. As a matter of fact, whether it was for this reason or any other, there were no such yachts entered for that race. Of course the question of liquid fuel is a very difficult one to deal with, and there are comparatively few yachts, or so few, fitted with it, I think, that it was hardly worth while upsetting the old construction to include it.

The question was raised by two speakers as to how the horse power was to be measured, whether by the coal burned, or the cylinder area, or the propeller. Of course we all know—all who have run trials—that the coal burned and the horse power got out of it depend very much on a great many circumstances, and it could hardly be taken as a fair measure of the power at all. If you have a certain grate surface, your design being otherwise good, given skilfull stokers and a proper engine (of course the better the engine the more credit the designer should get, and the more chances he would have in the race) then you have a fair measure. The heating surface would not give you any fair measure, especially if you had different types of boilers aboard.

Then, as to the question of forced draft, if more than 2 inches are allowed, the torpedo boats having been run with more than 2 inches, Mr. Parsons said that a keen sportsman would be willing to burn up his boiler in order to win the race, and consequently should be allowed more than 2 inches of draft to do it with. I think he should rather be severely cut down so that he is not going to burn his boiler, and therefore that a strict limit should be imposed.

In the paper the admiralty coefficient has been distinctly departed from, and in high speed boats that surely is correct, as the admiralty coefficient is very far from correct when the wave making resistance comes to be a very prominent element. That is to say, even with boats of moderate speed, we find, looking over the data of progressive trials, that the Admiralty coefficient is anything but a constant, and it has to be handled with very great care.

The question of the periodic variation of the resistance came up. Of course that would be very interesting to take into account if it were at all possible, but I don't imagine that it is possible to do it without considering each yacht by itself, and of course that would make anything that could be called a rule an impossibility.

Then the question of displacement arose. Of course, if you have a certain length and breadth and draft, and you begin to alter the displacement very greatly—that is to say, cut the displacement—you run yourself into a very great many difficulties. To begin with, you immediately run down our power of carrying any weight of machinery; and I should think that the specification

of the elements of length, breadth, and draft, and engine power, or grate surface, which practically measures it, would limit you within very long limits, and would require great intelligence to make the best choice of the displacement.

There is one note that I would like to make in connection with what Colonel Stevens said. He proposed exactly the same design for all yachts. Of course this rule was made by Admiral Melville for yachts already existing. There was no proposal to build special yachts. There was no time to build special yachts Consequently any limitation as to what the design of the yacht was to be would not answer at all. In fact I didn't imagine until the interest in the race got up to the pitch that it has in regard to these America cups, that we would ever have so much money to spend on building racing yachts. I think that is all I need to say on the subject, except to repeat, of course, that this is not Admiral Melville's reply, and what I have had to say in reply should be cut from the transactions.

ON THE RULES OF LLOYD'S REGISTER FOR BUILDING YACHTS TO CLASS.

BY GEORGE STANBURY, MEMBER.

ABSTRACT.

This paper describes the new yacht rules adopted by Lloyd's Register, after consulting prominent yacht designers, and is formulated for the purpose of complying with modern design and construction. The principal change has been the introduction of a new measurement termed the "bilge diagonal" in ascertaining the rating numbers. While the previous rule made use of the measurement, one-half the girth, this did not satisfactorily discriminate between normal full forms of ordinary steam yachts and racing yachts of fine form. The scantling basis adopted under Lloyd's rules for all types of yachts is practically the same as was formerly used for steam yachts, but with the modifications of the above-mentioned bilge diagonal. The rules have not only been modified but many additions and extensions have been made. Numerous illustrations have been added showing approved methods of construction in wood and metal.

DISCUSSION.

PROFESSOR SADLER: Mr. President: This paper is, I think, exceptionally interesting in that an attempt has been made to introduce the displacement by means of this bilge diagonal N. We all know that the binding moment varies as the product of the displacement of the vessel and the length; and the sheering force may also be taken to vary with the displacement; so that in fixing the scantling of any vessel really the displacement should be a governing factor. And it is very interesting to see that this factor has been practically introduced into this new rule by means of the bilge diagonal N. In regard to the length, it would be obviously unfair to vessels with a straight stem to let them have the same length for scantling purposes as those with large overhangs.

It is also interesting to note that although no mention has been made of the straining action due to sails, or the deep lead keel, that this is implied in the measurement of girth and depth; by taking the depth of the bottom of the lead keel a tax is at once put upon the ballast and the straining action.

MR. STEPHENS: Mr. President: This paper deals with a subject whose importance is recognized at this time more than ever before on both sides of the water. There has been no attempt in the country to restrict the scantling of yachts until within a very few years. About eight years ago I was called on by the Yacht Racing Union of the great lakes to prepare a table of scantling for their yachts. This I did, expending a great deal of time in rather an unknown field, as nothing then in existence covered the particular case of the yachts as they then existed. This table worked very well. It is still in force. A number of international races have been sailed under it, and, I think, it has proved successful. The only important change has been that, while I did not attempt to limit in any way the materials, that has since been done. Men were found to be using white pine where oak should be used, and they have supplemented the original table of sizes of scantling with the limitation of materials for certain parts. These same scantlings—that is, this same table of scantlings—has since been used in the east, about Boston and New York, with modifications to suit local conditions, and within its limitations it has worked pretty well.

At the present time all yacht clubs and yachting communities are alive to this question of the advisability of some limitation to light construction. The trend of designing of late years has been to cut the displacement, and that means to cut the construction; and yet it is safe to say that the designer to-day knows no limitation on his work as to cost. Given an amount of money, and a pretty liberal amount, he will cut the weight of any existing yacht by quite a fraction.

At one time Lloyd's tables were based on the current practice of the day in yachting, as that practice was developed in England, to the cutting off of beam and the addition of lead to keel; no attempt was made to follow the course of evolution in yacht designs, and designers had a free hand for many years. Of late years, and quite recently, in answer to the demand of yachtsmen Lloyd's rules have been very thoroughly amended, and they stand to-day, I think, as an index of pretty good construction. Now it rests with the yachting clubs to deal with this subject in some active manner. It is under discussion all the time, especially the subject of imposing some scantling regulations, and it seems to me that Lloyd's rules as they stand offer a practical working basis. They have been framed with great care, and after an enormous amount of experience. They represent years of change, and constitute a good working basis for the adoption of scantling restrictions which are so obviously needed in yachting. I think, therefore, that more may be obtained by working in harmony with Lloyd's to improve the existing rules, if necessary, than by making independent and conflicting measurements.

In the absence of the author Mr. Cox then read the following paper.

THE POSITION OF THE CENTER OF LATERAL RESISTANCE.

BY L. E. BERTIN, ESQ., MEMBER.

ABSTRACT.

This paper is a treatise on the position of the center of lateral resistance based upon experiments on models of a few typical vessels carried on by the author several years ago. This point is that at which the resultant of all forces tending to resist the lateral motion of the vessel must be applied. Its position is not generally known. Such knowledge, however, although not of the first importance, is of practical value in calculating the heeling moment of sailing vessels, or in investigating the angle of heel produced by some vessels while turning.

DISCUSSION.

MR. PACKARD: Mr. President: I see no mention here made of the length of the rudder. The depth of the rudder is also a significant factor. Whether you have a rudder up near the surface of the water or have a deep rudder makes an enormous difference. The forces in action when the boat is turning are the centrifugal force and the lateral resistance, and this of course depends on the rudder. The rudder acts in an opposite direction to the lateral resistance. If the boat has a long, deep keel it takes a great deal of power to turn her. The effect of the rudder is great if she has a short keel, and it takes very little power to turn her and the form of the rudder is comparatively unimportant. I am told that in designing torpedo boats they depend a great deal on the rudders to prevent them from capsizing. In some of the early types they had a shallow rudder, which allowed the boat almost to capsize in turning rapidly; then they made a deep one and entirely obviated this risk. The depth of the rudder is therefore very important in matters of this kind.

Another important point in designing high-speed steamers is the shape of the fore-and-aft lines, from which a good deal of difficulty sometimes arises in respect of the lateral resistance. If you have a boat with a flat keel, as illustrated in Mr. Crane's paper, this difficulty is in a great degree overcome; this is simply due to the fact that the boat had a flat keel and the fore-and-aft stream line and diagonal lines are very nearly horizontal instead of semi-circular. The Herreshoffs found that out about 20 years ago, and in designing high-speed vessels of all kinds they pay a great deal of attention to the shape of these fore-and-aft lines. That has a good deal to do with the resistance, and it is not necessary to make a broad stemmed boat in order to prevent this difficulty.

MR. HOVGAARD: I happen to think of a very good illustration of what the last speaker said about the torepdo boats being affected by the rudder. Some 15 years ago we had a small torpedo boat in the Danish navy—No. 10—which had two rudders, but she had had very little stability. She was out one morning when there had been some rough weather during the night and there was a heavy swell running outside off the port of Copenhagen. The boat was of only 15 or 16 tons displacement, but she had occasion to turn very sharply. She used the full power of the rudder and was going at full speed. In turning she was all right, because the rudder acted against the centrifugal force. She would heel over out of the circle, but the rudder being placed below the center of gravity would keep her up; but the moment the helmsman eased the rudder, which he did very suddenly, the boat turned over and sank immediately. That, I think, is an interesting illustration of that point. The boat had a sister vessel and we reduced the area of the rudder practically 5 per cent. after that, and lowered the center of gravity somewhat by placing some ballast in the bottom of the boat. Then we tested her, and still, at full speed and with the full rudder, she would heel over a good deal, and showed the same tendency when we eased the rudder. When the boat I speak of capsized the action of the sea, of course, had something to do with it.

MR. MCLEAN: Mr. President and Gentlemen: Mons. Bertin's paper seems to have been written chiefly to disabuse the minds of the average person of the ordinary definition of lateral resistance. Usually it is taken at the geometrical center of gravity of the longitudinal plane. Here it is taken at the center of the resultant forces made up of the resistance of the air and of the fluid pressure underneath. It is very nicely shown in sections of Mr. Webb's vessel, the *Donderberg*. Everyone knows that the center of pressure is one of the hardest points to calculate, and the writer has gone on to state that by the result of actual experiment he has found the outer position of the center of lateral resistance to be at the point *O*, and I believe he has indicated the only way of finding it.

MR. MAIN: Mr. President: The remarks as to the center of lateral resistance as we find it calculated, and as we find it here, are followed by the record of two experiments. These, I think, are useful only for comparing with data derived from other models. I think the truest way to get the center of lateral resistance, or to know the relation of the center of pressure to the center of lateral resistance, is to make a model of the vessel as near as possible and rig her up and sail her; and then you will find that the position of the sheets and the strength of the wind have very much to do with the lateral resistance when the vessel heels over. Then, of course, the center of lateral resistance travels forward, which also gives greater moment between the center of true lateral resistance and the center of impulsion of the sails and sends the boat up into the wind. I think that is a point often lost sight of by many yacht designers and naval architects.

THE PRESIDENT (taking the floor): Gentlemen: I take pleasure in coming down on the floor again for a moment to remind you that the chair cannot discuss these papers. But I have felt that it was necessary for someone to come down and stir you up, as I have had the pleasure of doing in old times, and to prompt a discussion of the papers which come before us. Every remark adds some value to them and to the value which they convey to the members who are not present. It has been a great pleasure to me to find such an old friend as "The Center of Lateral Resistance" could arouse so much discussion as it has already. I feel

sure that there are still others here who have made some experiments upon this matter in the course of their yachting experiences which would be of very considerable interest and value to many of our readers, and I earnestly beg of you to take a more active part in the discussion of papers which come before us. It will add very much to the pleasure of my duties in the chair.

In the absence of the author the following paper was read:

SUBDIVISION OF WEIGHTS IN SHIPS' DISPLACEMENT.

BY NABOR SOLIANI, MEMBER.

ABSTRACT.

The vagueness and uncertainty of the exact meaning and classification of weights of war ships and merchant vessels is appreciated by all who have to do with their construction or equipment. Such want of precision is also due to the complex character of the ship itself, which makes it difficult to tell where one part ends and the next begins. The author has written this paper with a hope of inducing some step being taken for the avoidance of this vagueness with relation to weights, and he proposes for war ship classification one which is followed by the Italian royal navy, and has proved to work successfully in practice. The ten subdivisions of weights proposed are as follows: Hull; hull appurtenances, viz., machinery, accessories, and fittings to hull; armor and protection; propelling machinery; military armament; electrical generating plant; navigating outfit; fuel; equipment; margin (corresponding to cargo in merchant ships). No classification, however, is satisfactory unless the boundaries between classes are distinctly and clearly drawn in every particular, and the author devotes several pages to describing the limits of each classification. The classification for merchant steamers and sailing vessels is along the same general lines, but naturally is simpler and eliminates certain headings.

DISCUSSION.

Mr. Hovgaard: Mr. President: I can only say that I hope the suggestions contained in this paper will be acted upon. I think it would be extremely useful to all of us if it were possible that such subdivision, clearly defined subdivisions of the weights, could be arrived at. Fortunately in the weight department in the Bureau of Steam Engineering they have a very clear definition of what is involved in the different groups. I think it does not matter very much how the grouping is effected, but, of course, it must be on some rational base or principle; but it does not matter so much if it is clearly defined and everybody knows the definition. There are, however, points in the grouping which are important, and I think that the armor deck ought not to be grouped under the hull, but, as Mons. Soliani recommends, the vital part of the armor deck, that is really a protection, should be reckoned to the armor weight, and that only that part which is equivalent to what it would be with an ordinary deck should be reckoned to the hull; for otherwise, in comparing ships with different shapes of armor deck, it will appear that one hull is constructed much heavier than another when it is really not so, which is, of course, unfair, because the excess of weight is really a matter of protection and not of hull construction.

The President (taking the floor): Gentlemen: It seems to me that in connection with this paper it ought to be understood that the Navy Department and the construction officers of our navy have probably been more generous on the subject of information in regard to weight than those of any other government. The Navy Department has a most complete classification of the weights of the hulls known to exist anywhere, I believe, a classification prepared with the utmost care, and one which has been in existence now for a number of years. The return weights of the vessels built for the navy have now provided a mass of data which makes it possible for the designing of new vessels to proceed upon lines of some certainty. It is to be regretted that the author of the paper could not have given us some weights of some of the Italian vessels in which we are considerably interested. It would have been most valuable to us to have known, for instance, the amount of the item of margin upon the *Victorio Emanuel,* which has never seemed to me to ever have had other than a negative existence.

FOURTH SESSION.

The meeting was called to order at 2:15 by the president, who was afterwards relieved by Mr. E. A. Stevens, and later by Mr. Stephenson Taylor.

MAINTENANCE OF MACHINERY IN MERCHANT SHIPS.

BY ROBERT HAIG, ESQ., MEMBER.

ABSTRACT.

This paper is one of the most valuable practical treatises which have been presented to the society. The maintenance of machinery in merchant ships is a problem that is steadily becoming of higher importance by reason of the increased size and power and of the great complexity of machinery now found on board high powered vessels, and also because of the increased demands now made for a higher efficiency in machinery and the personnel of engine room. The author, who is a surveyor of a classification society, has had abundant opportunity for noting the defects and breakdowns in marine machinery, and treats, under the heading of engine fittings, shafting, condensers and boilers, forced draft, oil fuel, superheated steam, steam pipes, and pumps, of the care and attention that should be given these parts for their efficient maintenance. His observations are not only general but take up in detail those points about the boilers and engines which are the greatest source of trouble to the engineer and which require the most careful attention. Under the heading of boilers are given perhaps the most valuable remarks concerning the points where weakness, distortion, and cracking of plates are generally found, and the way of running boilers to reduce such troubles to a minimum.

After reading the paper the author made the following comments and explanations:

After the words: "The packing of condensers is generally supposed to be a simple operation" (page 5), the speaker added: The reason I say that is because I have often found that it is a job which is entrusted to

apprentices, and is supposed to be a job that does not require any great skill or experience.

After the words: "In some ships corrosion in copper and other pipes in the bilges have been traced to the use of certain animal or vegetable oils" (page 7), the speaker added: The Russian volunteer boats having mostly copper pipes in their bilges, have had no end of trouble. These ships were built to class with Lloyd's Register, and we know that they have had a great deal of trouble, and much of it was found to emanate from the fact that they use olive oil, a vegetable oil. They found that there was a very active corrosion. The copper pipes would many of them fall to pieces.

After the words: "Mr. Yarrow conducted a series of experiments in 1891 and showed conclusively that with every change in temperature the conditions of the tube plate and connections changed proportionately" (page 11), the speaker added: Mr. Yarrow took a type of old-fashioned locomotive boiler and made experiments with it. He carefully noted that the effect of opening the furnace door was to lower the temperature. When the furnace was at a high temperature the tube plate was pulled in, and when it was lowered it was pushed out. And the change went on with perfect regularity, which proved that there is an expansive movement there.

After the words: "It is, however, not desirable to raise steam too quickly," etc. (page 17), the speaker added: There is another feature to be considered if you get a big power of engines. Some time must elapse before you can warm the engine up to full power. Even supposing you had the steam, it is a very rash proceeding to start away with engines not thoroughly warmed up.

DISCUSSION.

Mr. Wheeler: The subject of the deterioration of tubes is a burning question, but I think a great deal of the trouble is due to bad material. Of course, it is very desirable to get homogeneous tubes, but it is very difficult to get them. Electrolysis, however, has more to do, I think, with stationary plant than aboard ship. In many cases, I think, it is pure and simple galvanic action which causes the trouble, and this is more or less affected by the quality of the circulating water. We find, for instance, in New York harbor, that boats lying around docks have more trouble with their condensers than sea-going vessels. I have in mind some boats that were occupied a great deal on a branch of the East river near Greenpoint, among the oil refineries, where they were obliged almost to give up the use of surface condensers. In fact, one of the largest owners of tug boats (I think it is the New York Central) has practically abandoned surface condensers for jet. Even now they have trouble. On the Passaic river they have had no end of trouble, even with jets. Of course, we know what the Passaic river is. It is nothing more or less than a system of sewers, with animal substances coming down from those sewers and all the outlying villages as well. I have in mind a case where the valve bolts in the air pump wore down to almost 1-10 of their diameter.

I have found in condenser tubes, where the circulation was not uniform, that some have been doing more work than others. Those were the tubes that were the first to go. In the case of double tube condensers, annular tubes, I also found a very remarkable effect. At the end of the inner tube, where the current passed and turned around and came back, it would actually cut a hole just as if a file were used, at one particular spot, at a certain distance from the end of the small tube, through a combination of chemical and, you might say, mechanical action. The practice of the navy is to place zinc not only in the condensers but in the pipes, and even in the pumps, or wherever they can get a piece of zinc conveniently placed. In fact, I saw one design in which they placed short fingers of zinc into the pipes, which could be readily taken out for repair, or for being replaced with new pieces of zinc when worn out.

I would like to call attention to another point. Mr. Haig speaks of packing condenser tubes. There is nothing that should receive more attention. You have to allow for expansion and contraction. But I find that this is a very useful way of reducing to a minimum the number of packings. (Illustrates on blackboard.) This is one end of the tube, thickened, like that—cutting a slot here, and chasing the thread here, and securing it right into the tube here (indicating). This end of the tube plays through the usual packing. We provide for expansion and contraction at one end of the tube, and for anchoring at the other end.

Mr. Haig hardly touched upon, in fact, he omitted it from his paper, the subject of pumps. As in the case of many other auxiliaries of ships, enough importance has not been given to the subject of pumps. People are not willing to spend enough money on them. I refer to this country. It is not so abroad. I hardly agree, however, in the suggestion that the valve seat should be cast solid with the chamber of the water cylinder, and for this reason, that it makes a more expensive pump of it, and it is hard enough to get people to make use of a more expensive type of pump. They usually buy iron pumps brass fitted, and if you cast them in the way suggested it makes it very expensive. Valve seats can be put in or driven in to suit, but there is always a possibility of their coming out. But at the same time the problem has been solved with fair success, and the last dozen or twenty battle ships and cruisers have brass composition decks, with the seats solid with the deck; in other words, there are groups of small valves not exceeding 2 inches in diameter. I don't believe in large valves, unless you want music. Of course, the modern practice, in the case of the higher pressures, is to have the valves enclosed in castings called pots, thereby reducing the weight to a minimum, and bringing up the strength to resist the higher pressures now prevailing.

I think that it is a very wise thing to reduce the steam pressure, and certainly it is more economical in the matter of pumps, because we have not there the elaboration for expansion and contraction, and we all know that the greater the range of temperatures the greater the cylinder condensation; besides, this method is more practical and less liable to break down, and requires less weight. I would suggest 125 pounds as a very good maximum figure for such auxiliaries as the pumping plant. This is a very good pressure on economical grounds, and people should look a little more to economy in these auxiliaries. There is no reason why we should use from 20 to 40 per cent. of all the steam generated in the auxiliaries, though you will find, if you investigate the matter, that that is the rule. But among the

best type of auxiliary machinery I believe they have got it down to somewhere between 10 and 15 per cent.

A Member: For long trips?

Mr. Wheeler: Yes, for long trips. But the average is about 35. A paper read here yesterday showed that the indicated horse power was only about 5 per cent. of that of the main engine. A paper read before this society not many years ago showed that on the *Minneapolis* the electric generating engine took about 100 pounds per indicated horse power. True, the valves were not in very good order, and the party overhauling them got it down to about 50. You may imagine how much coal was necessary.

Mr. Forbes: The supplementary remarks about electric light plants I am glad to see in one way, and sorry in another. They don't admit of any such consumption of water to-day. The government is particularly exacting.

Mr. Howell: I remember very well a paper written by Assistant Engineer Hall of the navy. During a two years' cruise he made exhaustive water tests of all the auxiliaries, and I think some of the results showed as high as 200 pounds per indicated horse power, for instance, on high-pressure steam pumps; and it has always seemed to me that while the large increase of auxiliary machinery on modern vessels is a great convenience to the engineer, it would be a very good thing if we could go back, to a certain extent, to the old style arrangement of air, feed and bilge pumps driven from the crosshead. I don't see how the water consumption can be cut down to any great extent with the elaborate arrangements which we have to-day. Compound acting steam pumps are, of course, better than the simple steam pump, but even on those the consumption is growing.

There is a passage on page 17, in regard to water-tube boilers, which meets my idea exactly. We found on the *Minnesota,* which I guess has about the largest installation of water-tube boilers in merchant work of late years, that it simply came down to a little more than a question of the intelligence of the fireman. It was a matter of the water tenders looking out for the water. And my idea, since that experience, is that it would be better to cut out all the automatic feed arrangements from water-tube boilers, and put them on the same level as Scotch boilers; that is, put it to the water tenders to look out for the water level. They will have to pay more attention to business than with Scotch boilers, but that is the only basis upon which they can be run. Automatic arrangements on the boiler for regulating the water level are simply a bid for carelessness and disaster.

The President: Any further remarks? Does the society understand that our old friend Water-Tube Boilers is up for discussion? It seems to me that some of the engineers might give the society some very valuable information on the question of propeller shafts.

Mr. Haig: Regarding what Mr. Wheeler said about valve seats and pumps, what he said about a number of small valves being grouped on the plate is simply what I have indicated; but that driven-in valve seats are a nuisance has been proved again and again. In a trial trip of a boat that I know of the trip was practically stopped on account of the valve seats coming out of one of the feed pumps. In my opinion auxiliaries get very scant attention. I usually find them in a very inefficient condition, and I can only infer that they do not receive anything like the attention that they ought to.

Mr. Wheeler: Don't you think that people who install these auxiliaries do not show the care they might?

Mr. Haig: I am not speaking of those who install them, but of those who attend them.

Mr. Wheeler: There is no use having a good thing if it is not taken care of with the greatest intelligence. I find that many auxiliaries are not done justice to in order to keep them up properly, and those who have charge of them have great fault to find with them for that very reason.

Mr. Howell: The trouble with some of these elaborate outfits of auxiliary machinery is that it is impossible to give them the care which they ought to receive. I remember on the *Ohio* some years ago I asked the assistant engineer in regard to the construction of the heater. He said: "I don't know what the construction is. It works, and that is all; I have never had a chance to open it."

Mr. Wheeler: If you have a good air pump exhausting into the receiver of the engine or into the feeders you practically have a connected pump. You simply take out of that steam a certain amount of heat and pass it back to the engine, with this advantage, that you can regulate that pump to any speed you like. And what is more, you are not troubled in your mind about the breaking down of the pump. A few accidents which occurred on the Cunard line on ships were due to the smashing of the air pumps when the ship got to racing.

Mr. Howell: Of course, in those things it is a matter of compromise. There are advantages and disadvantages. My idea was simply that it would be well to cut down as far as possible some of the auxiliaries. I think that in some of the ships it has been carried too far. Of course there must be danger in racing. But some of the air pumps that I have seen lately have raced, and auxiliary air pumps have raced. They have gone at a terrific speed. Of course, it is a great advantage to have an independent air pump and a circulator, but it seems an unnecessary thing to go to this expense to save steam, and then put in a set of auxiliaries which are admittedly wasteful. It seems almost like saving at the spigot and wasting at the bunghole.

UNIFORM SPECIFICATIONS.

By W. D. Forbes, Esq., Member of Council.

ABSTRACT.

The argument of the author for a uniform specification is based upon the reason that the builder who is held responsible for the machine supplied should himself decide what materials go into the machine. One of the abuses of some present day specifications is that they do not specify, but demand information which the builder considers a trade secret. The builder who has made a life study of a certain type of engine naturally knows more about the requirements of such a machine than the purchaser. In concluding, the author holds that if there is a specification for an article it should be lived up to, else the article should be entirely rejected; that no responsibility should rest on the maker except for good work; on the other hand, if there is no specification, the maker should be held responsible by

bonds for the satisfactory working and lasting qualities of the article.

DISCUSSION.

THE CHAIR: You have heard the paper read, gentlemen. It seems to me there is meat in it for discussion. We should be very glad to hear from any one of you. It seems to me there are one or two suggestions in this paper that are worth taking up. This last one strikes me as rather a peculiar one. I think by the time the writer has been a constructor as long as I have he will not desire to be asked to give bond for anything. This question of what is first-class is also a very peculiar one at times. I have written a great many specifications and have read many more, in which there has been called for workmanship of first-class character and material of first-class character, but just what is first-class is always left indefinite. The matter of specifications, therefore, has always been for me a very peculiar one. I very well remember many years ago that Captain Bradbury came from the Pacific ocean to contract for two steamers to be built here, to be carried over and delivered in San Francisco harbor. After some little talk about the general dimensions he gave the company of which I was then a member the contract to build the machinery, and the president remarked: "We will prepare the specifications for you and present them with the contract." And the captain, with a sort of dry smile, said: "No; I don't care about any specifications. I understand you furnish it all complete in the very best manner." The result was that there was nothing left out, I assure you.

The two following papers were then read, and as they referred practically to the same subject they were discussed together.

HIGH SPEED GASOLINE LAUNCHES.

BY CLINTON H. CRANE, ASSOCIATE.

ABSTRACT.

In this paper the author points out the great development made in high speed gasoline launches during the last year, and especially with regard to the engine. By reducing the weight to a minimum and by adopting the automobile type of motor, a brake horse power is now obtained on from 8 to 20 pounds of machinery, which is 1-10 the average weight of the older makes of motors. This reduction has been accomplished, first, by cutting out unnecessary material, the employment of higher grade material, and the use of higher piston speeds. The balance of the paper is devoted to a description of the *Vingt-et-un*, designed by the author, and to a series of trials unusual for this type of vessel. Runs were made over a measured course with engine speeds between 380 and 850 revolutions, with a view of obtaining the rate of increased power at speeds not already investigated. The results of these progressive trials are plotted for propeller efficiency, apparent slip, resistance in pounds and brake horse power, with the varying speeds.

SPEED AND POWER OF RECENT MOTOR BOATS OF SEVERAL TYPES.

BY ALPHEUS A. PACKARD, MEMBER.

ABSTRACT.

This paper presents in tabular form the data collected by the Eastern Yacht Club on the speed of fifteen motor boats. The club desired to obtain exact figures on this subject and, therefore, during the last summer, speed trials of these vessels were run on which the observations were most carefully and accurately made. The dimensions of the boats tried are recorded in a table accompanying the paper, and the speed formula for rating given by the American Power Boat Association is discussed. Several photographs of power boats going at different speeds are appended, and the author endeavors to show that at increased speeds the frictional resistance increases at a lower ratio beyond the "critical speed."

MR. PACKARD: A great deal of care was taken in checking the results, and I think they are very accurate. The parties very kindly allowed me to use their data, and I have added some other data obtained from different sources. (The author then described the wave formation shown in the illustrations accompanying his paper.)

In a high-speed boat there is undoubtedly up-hill resistance. The vessel is supposed to be very small, and is on the side of a very large wave. The buoyancy of the water acts at right angles to the wave's surface; that is, it extends backwards in these resultants. Attention was called to this matter by the elder Froude in the discussion of his paper in 1877 before the British Institution of Naval Architects; and then, again, in 1881, the younger Froude didn't mention that, but accounted entirely for the resistance as due to the coincidence of the wave crests. This undoubtedly applies to boats and ships up to the time when they are making a wave as long as this is. When they are going faster than that there seems to be a new law which has been very clearly brought out by experiments this year; and that refers to the up-hill resistance. The coincidence of the bow and stern system of waves does not make much difference to the resistance, and I think the humps and hollows—to reason backward—in the more moderate speed boats are probably due to this up-hill resistance. If you will notice Mr. Froude's paper you will see that whenever the stern is unsupported a hump arises, and he explained it as being due to the neutralizing of the bow system of waves counteracted by the stern system. The changes at this high speed can be accounted for by pulling the boat up hill as well as up the coincidence of the wave system. Mr. Froude called attention to the fact that the diverting bow system of waves, after they leave the boat, do not, of course, affect the boat's resistance. And the power required to create these bow waves is not given back to the boat in any way. The only power given back is due to the transverse system of bow waves punching the stern and pushing the boat along. And this undoubtedly accounts for part of the resistance at these more moderate speeds. The wave making is enormously important. There is one more point to call attention to, namely, the importance of the wave making, as shown in these diagrams. The American Power Boat Association's rule was used for figuring the ratings, and the power for a certain speed varies enormously.

DISCUSSION.

PROFESSOR SADLER: In the first paper Mr. Crane rightly points out to what this has been due, and especially to the elimination of unnecessary material, and to

the use of higher piston speed. At present the maximum piston speed at which most of these engines have been run is in the neighborhood of 956. That is not at all excessive when we come to think of the piston speeds in use in torpedo boats at the present day; and although it might be thought a little dangerous to go much higher than that, personally I don't see that further advance cannot be made in putting up piston speeds still higher. I would like to know if anybody has had experience with gasoline engines run at piston speeds in the neighborhood of 1,400. In automobiles some of them do no doubt run at a higher speed than 956, and there is no reason why they should not be utilized in boats of this character. The attainment of these high speeds, of course, has been due also to the elimination of useless material.

With regard to the second paper, as to the question of the coincidence of the bow and stern crests, I agree with Mr. Packard that that accounts for very much in regard to this high resistance, especially with a length of wave that is formidable in comparison with the size of the vessel. In regard to the other point, that is, this up-hill motion, I am not quite sure that I understand what he means, but I think there is no doubt that the variation that occurs in the resistance curve is due to wave forms of some kind.

Colonel Stevens: I would like to ask whether the curve which the author plots as the resistance curve in his paper is the same as the figures which he derives from actual experiments?

Mr. Packard: Yes.

Colonel Stevens: I made some figures, and it seems to me that there must be residuary resistance. It looks as though the vessel would rise in a body out of the water and lose a large part of the resistance. The boat seems to behave very much like the flat stone which we used to make skip over the mill pond when boys, or like an æroplane. But certainly the problems raised are exceedingly interesting. I would also like to ask of some of the gentlemen who are more in touch with the question of autos than I am, as to the relation between the rate of horse power as calculated and the actual power developed in practice. Mr. Crane's case is that of an actual test and the only possible source of error seems to lie in the possibility that the engine might not always be working exactly as in the test.

Mr. Packard: I think Mr. Crane's work is a wonderful achievement, from the way she maintained her speed in rough water. I think that is a great achievement, as these little boats are often in rough water, for Mr. Crane has made a boat that is less affected by the roughness of the water than any in existence. Another thing he has done: that is, he has made a boat which does not change her trim much if any, although she has a narrow stern instead of a broad one. He shows that it is not necessary to have a broad stern to prevent a boat from changing her trim.

The curves are very interesting, especially the one that shows that as you go faster the slip of the propeller is less rather than more. I think in that case it is due not to the boat rising out of the water but to the fact that in the higher speed the propeller is getting closer to the crest of this first bow wave. If the wave was indefinitely larger and the boat very small the propeller would be right on top of the bow wave, and, of course, there the water is moving with the boat; that is, it not only adds greatly to the efficiency of the propeller but it also reduces the skin friction enormously. These two causes help the boat greatly to go at high speeds. Of course, some models do rise bodily out of the water. Some of the torpedo boats certainly rise out of the water when going at full speed. And this also helps to get higher speed in these boats.

A Member: Considered by itself, there is, perhaps, no reason why this speed should not run up much higher, but there are a great many practical difficulties in the way. One of the most difficult things to deal with is the matter of vibration. These engines are run, some of them, at as high a rate as 1,400.

Another point has been raised in the discussion, and that is the horse power of gasoline engines. The speed is so high and the power would be so great that an indicator card would not show anything. I understand they have introduced in Germany a photographic method of indicating measurements. Of course, the only fair or genuine test that is worth anything as to the power of a gasoline engine is an actual test. You can't figure it out as you can that of a steam engine under different conditions. The condition of the weather will affect the gasoline engine. A damp day or a dry day, when the pressure varies—all these things will affect the engine. Of course, under a certain set of conditions, you would always get a certain horse power, but who shall say that these particular conditions all exist during the course of a given trial? You can't expect extreme accuracy unless you have repeated brake tests made.

Mr. Witherbee: The horse power corresponding to a given number of revolutions in the laboratory need not necessarily mean the horse power corresponding to the same revolutions in a boat. The torque in a boat increases very much more rapidly than the ordinary torque. In reference to the question of the boat rising out of the water it is a fact that there has been more or less published on that subject to the effect that a boat usually commences from a stand by gradually increasing the speed, and then the boat sinks as a whole—that is to say, the center of gravity sinks. In other words, if you take the mean height at bow and stern from any given fixed plane of reference, the center of gravity of the boat settles until you get up to a speed which ranges from 8 to 15 knots, depending on the size of the boat. After that the boat begins to rise. But speeds have never yet been attained at which the boat rises enough so that the center of gravity has the height that it had when the boat was standing still when you refer it to the plane of reference. In other words, the boat is always lower in regard to some fixed plane of reference than when standing still, although the tendency is to come nearer to this plane of reference as the speed increases.

Mr. Cox: In looking at the question generally as to what results we get apart from the interest which there may be in these freak boats, it seems to me that we ought to expect actual aid from the Navy Department. Sooner or later the department is going to be interested in extremely high-speed boats driven by gasoline engines. But the department probably will not take up the matter definitely until it feels sure of its ground, and the yacht designer and the owner will have to go to a great deal

of trouble and expense in making experiments. But if we could prevail on our friends in the department to run tests in which the actual and relative speeds approach those that are realized in these exceptional cases, such tests would be of great use. There is no model experiment that I know of in which the speed is anything like what is now realized by the gasoline boat, and the whole problem of design confronts us when we approach these new conditions. In many freak boats results are established that we cannot understand. We don't know the efficiency of the propeller, and we don't know what the engines are doing. If we could get complete resistance curves it might aid us in avoiding going into the extremes of freak designs.

MR. WHITTLESEY: I would like to ask Mr. Crane if he would enlighten the society on the steering qualities of his boat in a sea way at a high speed. I understand that she is an unusual boat. A good many designs have a high-speed form, but not so many designs have a high-speed form which is good in a heavy sea way.

MR. STEPHENS: At the present time the automobile boat sport is largely without direction. There is an association here which has laid down a rule which seems to work pretty well, and it regulates the races and has done a certain work. But this does not fill the bill. It is a question with me whether, in the line Mr. Crane has indicated, there is not a chance for much wider experiment. They are making phenomenal speed, and there are going to be a good many of them run. Now is this new movement worthy of the encouragement of the Navy Department and of the ship builders interested in torpedo boat designs? Isn't there something which can give the movement proper direction at this time? In this connection the Eastern Yacht Club has done some very good work in a small way this year in making public the results of their races. They have only held a few races, but the committee, of which Mr. Packard is a member, has kept careful records of all the races, and they have tabulated all the measurements of the boats. They have published the result in an admirable little pamphlet which shows exactly what they have done. If other clubs would do the same thing it would do a great deal for the advancement of the sport.

MR. CRANE: There have been several points brought up in the discussion which I could and would have touched on in the paper but for the fear of growing tedious. There is no question in my mind that the boat does rise with reference to the water about her, and there is no question that she does not rise with reference to the plane of reference. But in the boat it is very clearly evident that the water passing her sides in motion is a very considerable distance below the same water when the boat is at rest. I should say, from my experience in the *Vingt-et-un*, that this difference is fully 4 to 5 inches, at full speed, as a mean difference in the level of the water passing the vessel, and, as Col. Stevens says, there is no other way in which we can account for the low rate at which the resistance increases. The variation for resistance, after 14 knots is reached, is as the 1.43 power, and we all know that the variation of skin surface, as determined by Mr. Froude, is as 1.83 power; consequently, the total resistance is varying at a less power than the wetted surface.

As far as the horse power is concerned, I fear I did not make the matter plain. The brake horse power curve, which we made with the motor, was with the carburator wide open, giving all the gas to the cylinders which they would take, and slowing the motor by adding weight to the brake. The steadily rising horse-power revolution curve rises almost at a straight line up to the point where the gases begin to wire-draw, as we should say in steam practice. Then the cylinder is not getting the full pull; and we reach a point where the power ceases to increase with that particular size of valve. In the case of the *Vingt-et-un* that point was 1,000 revolutions. In estimating the resistance below 68 horse power, and from the resistance the horse power record, we made an assumption on the work done on the screw. We knew from our screw experience that at certain revolutions the variation would be in a certain way, and we varied our resistance from our screw and worked back from that data to the horse power curve. The horse power curve exhibited at one point was not taken from the brake test, as you can see by looking at the paper.

As far as the piston speed is concerned, I know an occasion where this has been run up to 1,200, but the difficulties of ignition and other difficulties greatly increase with the higher speed. I think, however, we can look forward to reaching at least as high piston speeds as we obtain in steam practice.

A MEMBER: What position of the spark flash was used when the test was made?

MR. CRANE: The spark was varied at each tests. We found by experiment the highest point for a given revolution. As far as the towing models are concerned there was an experiment made last winter by the Napier firm. They towed from a 25-knot torpedo boat a series of models, and decided on one. The results from the boat did not bear out the results from the test. The behavior of this particular boat in a sea way, when she was not supported by the towing rope, was most atrocious.

As far as the steering qualities are concerned, the *Vingt-et-un* had no skeg whatever, as you notice. I have handled her many times in a heavy sea, particularly running with a heavy sea quartering, which is certainly the most trying position for a high-speed boat, and at no time have we had to slow the boat owing to yawing. The stern is not flat, but the dead rise carries directly aft, which, I think, has a very large influence on the steering qualities, together with the other shape.

As far as the resistance varying with the different positions of the wave crest is concerned, that is a thing which, I think, all of us can speculate about and very few of us can determine. We know that at certain speeds there are certain variations in the speed curve, and we can determine those points by actual experiment. And that is the important thing for us to know in making further designs. Turning to the resistance curve, we found in the variation that the point of change was practically the same relative point as in the various torpedo boats, and that the point of constant variation began at the same general point. The interesting thing to me was that from 14 knots up there was no further hump in the resistance curve, and that after the wave series had passed the stern the boat was going on at a perfectly steady increase of resistance.

Mr. Packard: It is very hard for me to explain just what I did mean by the up-hill resistance without a long discussion. A simple illustration is a boat towing a tender. When the tender is on the crest of the wave, or just in front of it, it will shoot ahead; when it is on the back of the crest it will slide down hill, until it comes to the next crest behind, when it will shoot ahead and then yaw around. This is done by small boats in a heavy sea. When the wave speed is about the same as that of the boats they will run down hill until they get on the back of the next wave, and they will stay there pending the slide back, and if the wave overtakes them they will shoot ahead again. This same effect seems to be due to the boat itself that creates the wave, when she is moving at the same speed as the wave. It is a complicated problem, but the more I study it the more I am convinced that this is the explanation of the small resistance of the high-speed boats. The change of trim due to the impact of the water has nothing to do with it. It is the actual shape of the water about the boat, that is, whether it is inclined or whether it is horizontal. That the boat does not need to change her trim greatly in the high-speed boats I think is evidenced by the photographs in my paper.

The President: There remain only two papers to be read, and it is suggested as both of these papers are rather in the nature of records of data than subjects for argument they be printed in the transactions without reading.

RECENT LAUNCHING PRACTICE OF THE ATLANTIC COAST.

BY ASSISTANT NAVAL CONSTRUCTOR R. H. M. ROBINSON, U. S. N., MEMBER.

ABSTRACT.

The author of this paper has compiled a great amount of data on the recent launches of battleships from Atlantic coast ship yards. As it came time to launch the battleship *Connecticut* from the navy yard, New York, it was desirable to obtain data as to the best practice in launching similar ships at private yards, and hence a careful investigation was made of this practice. The data ascertained, together with that of the *Connecticut* launch, are given in the paper. A set of interesting curves of velocity, the distance run, acceleration and friction coefficients plotted to time intervals, is appended to the paper. The special features in the launch of the *Connecticut* were the use of four dog shores as a prevention to creeping after the removal of the shores and blocks; a mask for checking the speed of the ship after afloat, and sand bags used for replacing some of the forward keel blocks.

RECENT LAUNCHING PRACTICE OF THE PACIFIC COAST.

BY EVERETT P. LESLEY, ESQ., JUNIOR.

ABSTRACT.

This paper, like the preceding, is a compilation of valuable launching data, and gives the practice on the Pacific coast, as indicated by the launch of the three cruisers, *California, South Dakota, Milwaukee,* built by the Union Iron Works. A detailed drawing is presented of the launching cradle for the *California,* and deserves special attention, first in the character of the support for the ground ways; second, the arrangement of crushing timbers under the fore poppet; and third, the releasing device. Where elevated, the ground ways are supported on A-frame structure. As a result of three crushing tests with Oregon pine, with the grain at three angles with the line of thrust, the fore poppet was so designed that when the stern lifted the crushing stress on the timbers, and, therefore, the weight per square foot on the plating and framing of the hull, did not exceed certain safe limits. The releasing device consists of a weighted car running on an inclined track; when the car is released from the launching platform it strikes and knocks out the trip shore which in turn releases the dog shore.

On Friday evening the annual banquet was held, with addresses by Secretary of the Navy Morton, Police Commissioner McAdoo, and others.

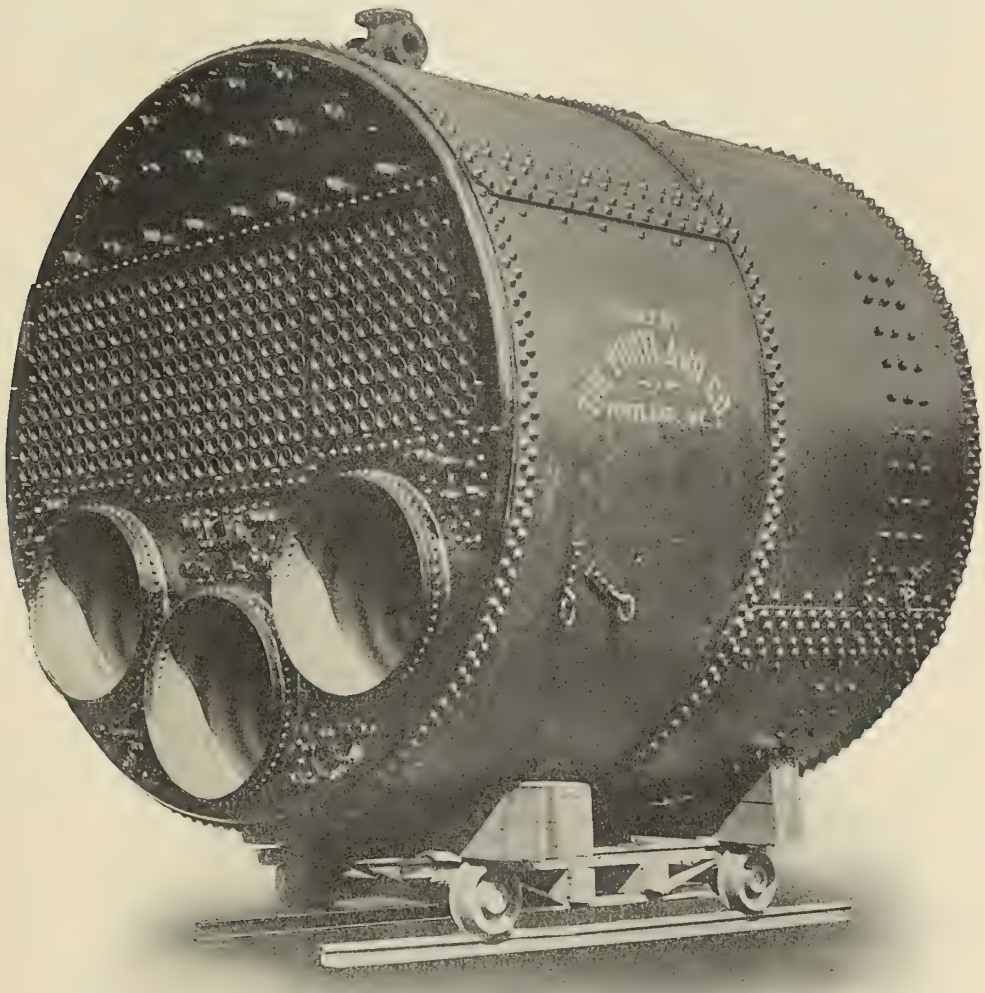
Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of November 10, 1904, the following degree of completion of vessels building for the United States Navy:

			Degree of Completion. Per Cent.	
BATTLESHIPS.			Oct. 1.	Nov. 1
Ohio	18 knots.	Union Iron Works	99.7	100
Virginia	19 "	Newport News Co.	68.6	71.21
Nebraska	19 "	Moran Brothers Co.	59	61.4
Georgia	19 "	Bath Iron Works	65.3	67.47
New Jersey	19 "	Fore River S. and E. Co.	69.1	70.7
Rhode Island	19 "	Fore River S. and E. Co.	71.2	73.5
Connecticut	18 "	Navy Yard, New York, N. Y.	53.59	56.4
Louisiana	18 "	Newport News Co.	59.68	61.5
Vermont	18 "	Fore River S. and E. Co.	21.5	25.8
Kansas	18 "	New York Shipbuilding Co.	26.6	31.2
Minnesota	18 "	Newport News Co	43.8	46.56
Mississippi	17 "	Wm. Cramp and Sons	10.24	11.89
Idaho	17 "	Wm. Cramp and Sons	9.98	10.61
ARMORED CRUISERS.				
Pennsylvania	22 knots.	William Cramp and Sons	90.5	94.79
West Virginia	22 "	Newport News Co.	94.2	95.5
California	22 "	Union Iron Works	64	65
Colorado	22 "	William Cramp and Sons	95	97.11
Maryland	22 "	Newport News Co.	90.57	92.16
South Dakota	22 "	Union Iron Works	61.5	63
Tennessee	22 "	William Cramp and Sons	50.06	54.85
Washington	22 "	New York S. B. Co.	44.7	50.2
PROTECTED CRUISERS.				
Chattanooga	16½ kts.	Lewis Nixon	97	97
Galveston	16½ "	Wm. R. Trigg Co.	91	94
St. Louis	22 "	Neafie and Levy Co.	51.1	54
Milwaukee	22 "	Union Iron Works	58.5	60
Charleston	22 "	Newport News Co.	83.2	84.34
GUNBOATS.				
Dubuque	12 knots.	Gas Engine and Power Co.	63.9	68.2
Paducah	12 "	Gas Engine and Power Co.	58.9	64.9
TRAINING SHIPS.				
Cumberland	Sails	Navy Yard, Boston	72	80
Intrepid	"	Navy Yard, Mare Island	56.2	63
TRAINING BRIG.				
Boxer	Sails	Navy Yard, Portsmouth	85	90
TORPEDO BOATS.				
Stringham	30 knots.	Harlan and Hollingsworth	99	99
Goldsborough	30 "	Wolff and Zwicker	99	99
Blakely	26 "	George Lawley and Son	99	99
Nicholson	26 "	Lewis Nixon	99	99
O'Brien	26 "	Lewis Nixon	98	98

MACHINERY OF THE NEW UNITED STATES HARBOR DREDGE KEY WEST.

A very strong, wooden dredge has recently been completed at the Portland Company, of Portland, Me., for the United States army, from specifications prepared by J. C. Sanford, Captain of Engineers, United States Engineer Office, Philadelphia. The dimensions of the hull are given on the data card, and the scantlings

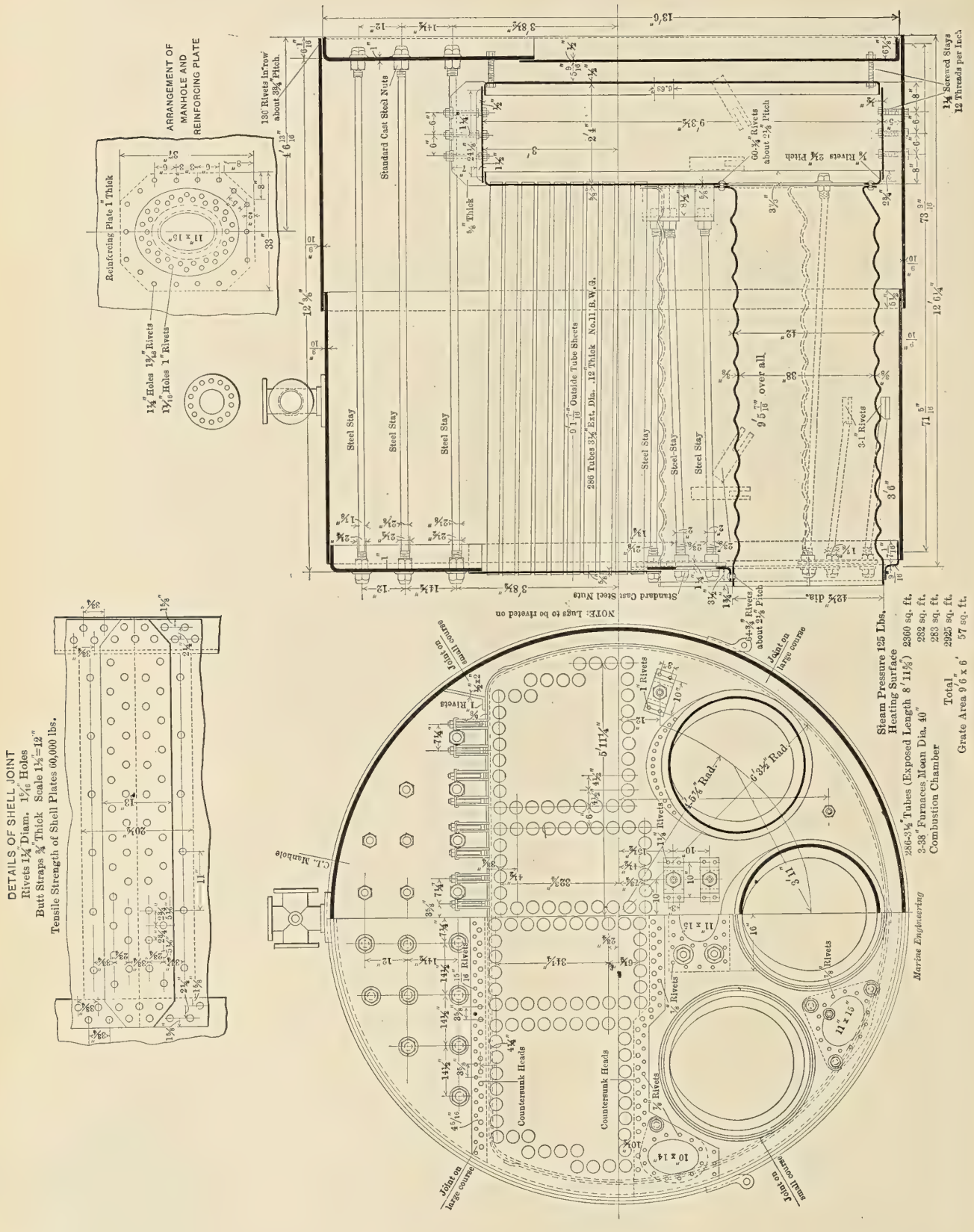


SCOTCH BOILER FOR THE UNITED STATES HARBOR DREDGE KEY WEST.

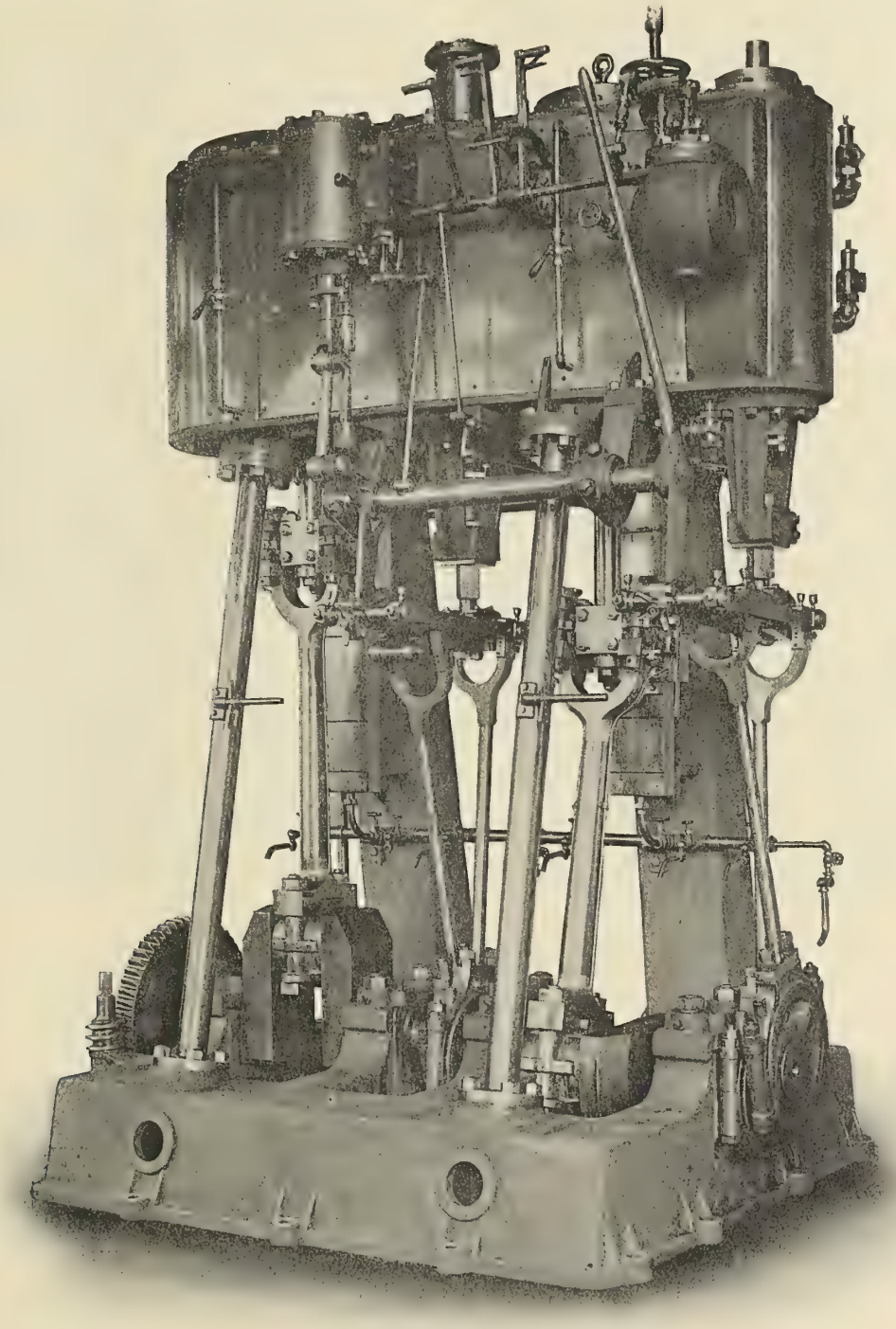
of a few of the members will serve to show how heavily this dredge is timbered.

Keel, oak, 12 by 12 inches; stem, 12 by 12 inches, oak; apron, 12 by 12 inches, oak; stern post, 12 inches sided; rudder post, oak, sided 12 inches, molded 14 inches. The frames are of hard wood, spaced 24 inches centers, doubled to mold 12 inches at the keel and 6 inches at the rail. The deck beams are of Georgia pine 12 inches sided, molded 12 inches at center and 7 inches at ends, while those beams at the ends of bins are to side 6 inches. Planking, Georgia pine, 4 inches thick on sides, 3 inches on bottom. There are two bins, one forward and one aft.

The propeller engine consists of a set of compound condensing engines, with cylinders 17 and 32 inches diameter and 24 inches stroke. The general arrangement of these engines is shown in the accompanying drawing, and is of the open-frame slipper-guide type, with turned columns at the front. Steam and hand reversing gears are fitted, as clearly illustrated in the engraving on page 575. The valves are operated by the Stevenson double link motion, and consist of a piston valve on a high-pressure and a double-ported slide on a low-pressure cylinder. The shafting is forged steel 7 1-2 inches diameter. A cast iron propeller, 7 feet 8 inches diameter by 12 feet pitch and with four blades, is fitted to the tail shaft. A separate plate shell condenser with 1,000 feet of cooling surface is fitted with 5-8 inch solid drawn tinned tubes. The air pump is double acting vertical type with a 7-inch diameter steam cylinder, 12-inch diameter air cylinders by 10-inch stroke.


ARRANGEMENT OF MANHOLE AND REINFORCING PLATE
Reinfreing Plate 1" Thick
11" x 15"
1¾" Holes 1⅝" Rivets
1⅞" Holes 1" Rivets
136 Rivets in row about 3¾" Pitch.
Standard Cast Steel Nuts
Steel Stay
Steel Stay
Steel Stay
Steel Stay
Steel Stay
Steel Stay
Steel Stay
Steel Stay
9'1 1/16" Outside Tube Sheets
286 Tubes 3¾" Ext. Dia. .12" Thick No.11 B.W.G.
9'5 7/16" over all
60-¾" Rivets about 2⅛" Pitch
¾" Rivets 2¾" Pitch
1¼" Screwed Stays 12 Threads per Inch
NOTE. Lugs to be riveted on
Standard Cast Steel Nuts
64-¾" Rivets about 2⅛" Pitch
12¾ dia.
Joint on small course
Joint on large course
Joint on small course
Joint on large course
C.L. Manhole
Countersunk Heads
Countersunk Heads
11" x 15"
10" x 14"
6'3½" Rad.
5'5¾" Rad.
5'11¼"
Steam Pressure 125 Lbs.
Heating Surface
286-3½" Tubes (Exposed Length 8'11½") 2360 sq. ft.
3-38" Furnaces Mean Dia. 40" 282 sq. ft.
Combustion Chamber 283 sq. ft.
Total 2925 sq. ft.
Grate Area 9'6" x 6' 57 sq. ft.
DETAILS OF SHELL JOINT
Rivets 1¾" Diam. 1 5/16" Holes
Butt Straps ¾" Thick Scale 1½=12"
Tensile Strength of Shell Plates 60,000 lbs.
Marine Engineering
DETAIL DRAWINGS OF THE KEY WEST BOILER, BUILT BY THE PORTLAND COMPANY.

The auxiliaries include the usual equipment of circulating, feed, sanitary, and fire pumps, injector, siphons and feed water heater. There is one Scotch boiler installed, 13 feet 6 inches diameter by 12 feet long, illustrated on preceding pages. This is fitted with three Morrison furnaces connecting to one combustion chamber; the total heating surface is 2,925 square feet and the total grate surface, with 6-feet bars, 57 square feet. The boiler is designed for 125 pounds pressure. The vertical donkey boiler, 42 inches diameter and 8 feet 3 inches high, is built to stand a working pressure of 125 pounds.



COMPOUND PROPELLING ENGINE OF THE UNITED STATES HARBOR DREDGE KEY WEST.

The pumping engine consists of a direct-connected, compound condensing engine, with cylinders 12 and 22 inches by 14 inches. The high-pressure is fitted with a piston valve and the low-pressure with a slide valve.

The 15-inch, centrifugal type pump of extra heavy construction is specially adapted for dredging. The runner is designed for from 200 to 250 revolutions per minute, and is capable of raising and discharging against a total head of 14 feet, 60 cubic yards of water per minute. The pumping equipment includes the customary suction pipes, which are 15 inches diameter, and discharges to the forward and after hoppers, apparatus for raising of lowering suction pipe, etc. The vessel is lighted throughout by electricity. The trials, which were recently carried on at Portland, resulted satisfactorily.

Making a Nut at Sea.

During a voyage to South America some fifteen years ago, the square thread nut in the ram of the lubricator gave out. The nut was six threads per inch. We had no dies or taps to cut a square thread, but as I was second engineer it was my duty to repair it. My first plan was to run a nut of babbit metal, but owing to the excessive pressure this ran only about three hours, and of course I was subjected to the usual amount of guying for its failure. This put me on my mettle—in more ways than one. I took two pieces of pine and dowelled

VIEW OF THE SUCTION HARBOR DREDGE KEY WEST, TAKEN DURING DOCK TRIAL.

MARINE ENGINEERING DATA CARD. DECEMBER, 1904.

NAME—Key West. NATIONALITY—American. TYPE—Harbor suction dredge.

LAUNCHED—1904. BUILDER—Portland Co. OWNER—U. S. Army.

Length over all.....141 ft.
" between perps.....130 "
Beam, molded.....31 "
Depth, " .....15 "
2 sand bins—1 forward, 1 aft.

Propelling Machinery:
Type of engine (one).....compound
Cylinders.....17, 32 ins. by 24 ins.
Shafts, diameter.....7 1-2 "
Condenser, surface.....1 000 sq ft.
Air pump, indep.....(1) 7, (2) 12 by 10 ins.

Propeller:.....4 blades, cast iron
Diameter.....7 ft. 8 ins.
Pitch.....12 " 0 "

Boiler:.....one Scotch
Steam pressure.....125 lbs.
Diameter.....13 ft. 6 ins.
Length.....12 " 0 "
Tubes (286).....3 1-2 ins. by 9 ft. 1 7-16 "
Furnaces (3).....38 "
Grates.....6 ft.
H. S.....2,925 sq. ft.
G. S.....57 " "
Donkey boiler..vert. 42 ins. by 8 1-4 ft., 125 lbs.

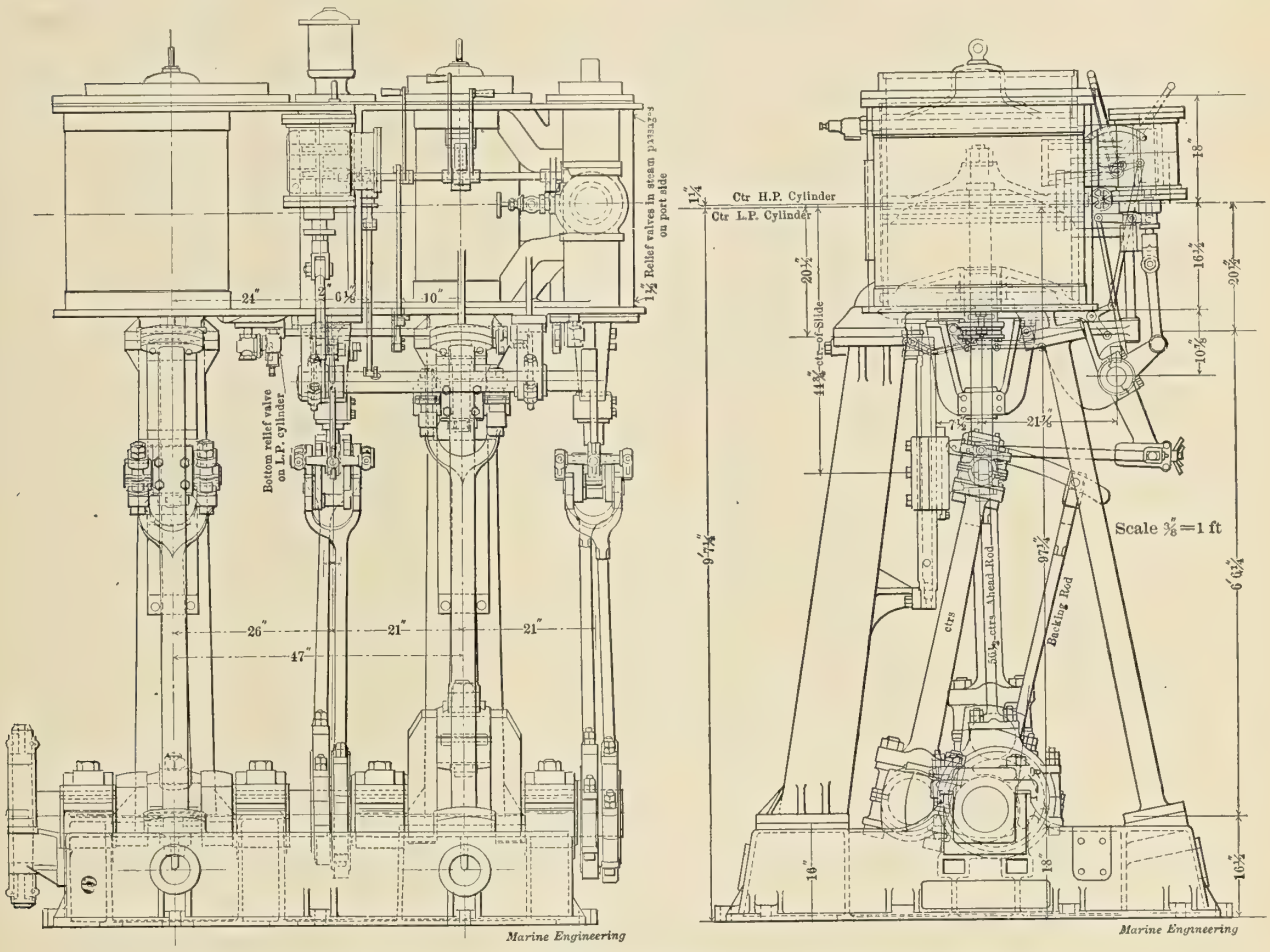
Dredging Machinery:
Engine.....one compound
Cylinders.....12 and 22 ins. by 14 ins.
Pump.....centrifugal sand, 15 "
R. P. M.....200–250
Capacity against 14 ft head, 60 cubic yards water per minute.

them together, heated the square thread screw and squeezed it between the two pieces of wood held in the vise, at the same time rotating the screw. This gave me a very fair core box. I then made a crucible of fire clay—used for repairing furnace bridges—made a core of fire clay, and finally a mold of the same material.

This time I melted some scrap brass in my crucible and cast it in the fire clay mold. The result was a fairly good square thread nut which lasted about four months, and when taken out to be replaced it was found to be hardly worn at all. E. A. SUVERKROP.

FREEBOARD.

Freeboard, as applied to vessels of the mercantile marine, being a subject of general interest to those engaged in the shipping trade, it is believed that a few of the details connected with its origin and subsequent official application in Great Britain as one of the means to prevent overloading, and consequent disasters at sea from such causes, will be appreciated. The following clause, which is to be found in a United States government circular letter, dated Washington, March 5, 1891, is the only indication in our shipping laws as to how



GENERAL ARRANGEMENT DRAWING OF THE PROPELLING ENGINES OF THE SUCTION DREDGE KEY WEST.

Wireless Telegraphy on Great Lakes.—When the season of 1905 opens on the Great Lakes it is expected that 10 wireless telegraph stations will be in operation. Four stations have already been placed in commission and six others are being erected or arranged for. This number is sufficient to keep a steamer equipped with wireless apparatus in touch with the shore from St. Louis to Duluth or Chicago. With this apparatus, which is of the DeForest system, a vessel may receive storm warnings and be in telegraphic communication with her owners during the entire trip, and her destination may be changed to avoid placing cargo in a glutted market. The saving of lives and property as well as giving better despatch to the vessel will doubtless result.

such freeboard or load line should be determined: "Section 2. . . . The owners, agent, or master of every inspected sea-going steam . . . vessel shall indicate the draft of water at which he shall deem his vessel safe to be loaded for the trade she is engaged in, which limit, as indicated, shall be stated in the vessel's certificate of inspection, and it shall be unlawful for such vessel to be loaded deeper than stated in said certificate." A limit to such load line, based on the depth of hold, but on that alone, is to be found further on as a complement to the circular in question.

The word "freeboard" denotes the height of platform, or, in other words, the height of the side of the ship above the water line at the middle of her length measured

from the top of the deck at side; or, in cases where a water way is fitted, from the curved line of the top of the deck ending on the plank next to the water way and continued through to the side, at which point of intersection it becomes what is known as the "statutory deck line;" the corresponding draft of water of the vessel with the freeboard assigned as above is the "load line."

In January, 1884, the British government appointed a royal committee to inquire and report upon the best means whereby a suitable load line might be assigned to vessels engaged in the ocean trade, and, about five years later, on the recommendation made by its commissioners, among whom we find the names of such eminent naval architects and shipbuilders as the late E. J. Reed, William Denny, Robert Duncan, Francis Elgar, Thomas Gray, B. Martell, and others, that government adopted a law making it compulsory for every British vessel to have a load line based on the freeboard tables already adopted by Lloyd's Register of Shipping, said load line to be assigned under the control of the Board of Trade. Up till that date, viz., 1890, the application of the freeboard tables adopted by Lloyd's committee was optional, except with reference to the classification of certain types of vessels, including those known as awning or shelter-deck ships, in which considerations of strength made it incumbent to limit the draft of water to a maximum; but, after the year 1890, and irrespective of the rules published by any of the recognized societies of classification, no vessel was allowed to leave port without a freeboard having first been assigned to her; and, although certain modifications have, from time to time, been made at the suggestion of the Board of Trade, or with their approval, to meet the requirement of some specific cases, this principle of the application of a maximum load line has been adhered to ever since.

Nearly fifteen years have elapsed since that law was promulgated in Great Britain, and, that country being still in the lead in matters appertaining to shipping in general, it is not surprising to find that although no other maritime country appears to have seen fit to enact similar regulations of its own, yet most of them have, unofficially at least, adopted the same rules, possibly because it was felt that none better could conveniently be devised. This, however, does not mean that no attempt has ever been made in that direction, and the writer is aware that in other countries, both in government and other circles, the question of assigning a load line has been raised. Unfortunately, it may be said, no conclusion appears to have been reached, owing chiefly to the opposition vouchsafed by a majority of influential ship owners, who, rightly or wrongly, fear the interference of governmental legislation and the possible prejudice any recognized limit placed upon the loading of their vessel might cause to their trade already hampered by so many other burdens.

There can be no question but that, apart from all other considerations, that of the safety of human life at sea is one of the greatest responsibility. This remark does not apply to the officers and crew of first-class transatlantic liners whereon everything that science, experience, and money can suggest and obtain has been devised for the safety and comfort of the passengers who avail themselves of this means of transportation; but, there are others, and not less deserving ones, whose devotion to duty under much less favorable conditions are also worthy of being cared for, and whose lives should be protected against any attempt to abuse the present indefinite state of the law in relation to the limit which should be placed upon the loading of ships. First-class vessels may be built and their general construction and scantlings may be such as to insure absolute seaworthiness against the elements under almost any circumstances. But, in every ocean-going craft, no matter how well designed, there enters a question of stability, the effectiveness of which depends largely upon the nature and disposition of the cargo. There also enters a very serious question of reserved buoyancy, the percentage of which as compared with the total volume displaced, materially affects the ability of the vessel to raise and recover herself from a succession of heavy seas shipped during a storm. If, then, such vessel be laden beyond the limit of safety, she may founder, and, like many others whose fate has never been definitely ascertained, may disappear with all on board, leaving only the widows and orphans to mourn the loss of the braves, who, for the sake of their reputation as sea-faring men, and a miserable pittance regulated by the universal law of supply and demand, were induced to risk their lives rather than shirk the responsibilities thrust upon them by the ignorance of some and the indifference of others.

A mere contemplation of the possibilities of loss of life at sea through the overloading of ships in general, would seem to call imperatively for some legislation on the subject; and, it appears almost incomprehensible at first sight that the example set by Great Britain in that respect has not been followed sooner by other maritime powers whose humanitarian principles are known to be identical. Therefore, it may perhaps fairly be assumed that whilst recognizing the desirability of enacting some uniform law susceptible of coping with the subject as a whole, other governments have met with much difficulty in trying to reconcile the various interests at stake as well as much diversity of opinion as to the technical merits of the present freeboard tables, which, owing to their actual standing, would naturally be taken as a basis for legislation.

It is not proposed to enter into the commercial aspect of the case, first, because we have no right to assume that any ship owner in this country would willfully send his vessels out to sea knowing them to be in an unseaworthy condition; and, secondly, because it is more within our province to deal with this question from a purely scientific and technical point of view.

The freeboard tables, to which reference has already been made, and which were included in the act of parliament adopted by Great Britain in 1890, were evidently of a tentative nature; and, although they may be said to have "held their own" until the present time, with what must be admitted as fairly good results all round, it will be sufficient for one to read the load-line committee's report, presented by the commissioners to the then president of the Board of Trade, to be convinced of that fact. The commissioners, even after availing themselves during a period of from four to five years of all the evidence placed at their disposal by ship owners, ship builders, masters, and others connected with the mer-

cantile marine, do not hesitate to admit that "a large discretion must be allowed to responsible authorities in applying the tables themselves with reasonable modifications to any very exceptional vessels which may now exist or may hereafter be constructed." They also "admit that undue interference with trade might occasionally arise were the tables to be applied henceforth to all ships, present and future, without any exception whatever." And, having thus exonerated their conscience by declining future responsibility, they deliberately adopted, with a few modifications to meet existing statutes which could not conveniently be repealed, the tables which Lloyd's Register of Shipping had been nursing and modifying about ten years, in the hope that by dint of repeated concessions the ship owners would see fit to accept them.

To clearly understand this it is necessary to go back to the eighties, when, succeeding to what was then known as the "Plimsol agitation," innumerable suggestions were made with the object of checking the scandalous loss of life due chiefly to the overloading of ships, many of which, however, were not even seaworthy, whether overladen or not. The late Mr. Plimsol undoubtedly deserves much credit for the improvements which may be said to have been almost directly due to the efforts he made in favor of the cause he so valiantly upheld, but it is quite possible that, like other leaders of an otherwise worthy cause, he was, through political influences, led into errors and exaggerations which his lack of technical knowledge did not enable him to fully appreciate.

The immediate result of the Plimsol agitation was that a load line was considered imperative; but, as there were practically no rules in existence for determining the position of that load line, to every ship owner was left the responsibility of fixing the draft of water which he declared he would not exceed in navigating his vessel. This elementary method of apparently settling the question, and which, after all, does not differ materially with present conditions in the United States, sometimes gave rise to peculiar misconceptions. While it is readily admitted that the majority of ship owners were, in such cases, guided by the result of their experience of the particular vessel to which such load line was to be applied, yet the writer knows of cases in which the Plimsol mark, as it was then called, was deliberately placed a foot or more higher up than could be considered suitable for the safe navigation of the ship, merely for the sake of the moral effect this exhibition would have upon the simple-minded sailor, whose satisfaction was complete so long as the Plimsol mark was *not under water.*

This, as also the differences of opinions constantly arising with reference to a suitable load line for any given vessel, made it almost a matter of necessity that some uniform rule should be adopted, and the question arose as to the most equitable basis for such rule or regulation. An old-fashioned method still much appreciated by some of our "ancient mariners," was to calculate the freeboard by an allowance of so many inches (say 2 to 3 1-2 inches) for every foot depth of hold; but, whilst this ready means of determining freeboard might have applied to vessels whose proportions of depth to length were of the usual kind as built some sixty years ago, it was quite evident that its general application in modern times would and did lead to the construction of long and shallow vessels whose extreme proportions in that respect were a source of structural weakness.

Moreover, it was felt that with the ever-increasing size of ships, as well as in consideration of the various types constantly devised to meet the requirements of the particular trade in which they were engaged, it was essential that, as far as practicable, each type, and even each vessel, should be dealt with upon her own merit; also, as science had materially helped in determining the strains to which such vessels are liable in a sea way, it was natural that science, coupled with the results of practical experience, should be called upon to determine the maximum draft of water suitable in each case, seeing that as a fundamental principle and apart from other considerations it is now universally recognized that strains in ships vary in proportion to their displacement and the effective sectional area of the material of which they are built. Hence the investigations started by a number of prominent men which resulted in voluminous interesting statistics supplied by various classification societies and others, with a view to providing sufficient data for the purpose and with the object of exchanging views as to the best methods to be employed.

The commissioners' report was unanimous in arriving at the results obtained, but, in dealing with this, as in the well-known case of the patient when doctors disagreed, each of the several parties in search of a remedy for the evil from which the mercantile marine was suffering, was prone to suggest a method of his own which did not altogether meet with the approval of the others. Some believed in one thing and some in another. One was of the opinion that the "height of platform" was of paramount importance, and others pinned their faith on the "reserved buoyancy."

In connection with this latter point it may be well to recall the investigations, also the results obtained and published by the late Liverpool Underwriters' Registry, at the head of which was Mr. Henry H. West, whom many will remember as one of the most genial of his kind. The report did not profess to fix a hard and fast line, but simply to offer some information for the guidance of ship owners and underwriters by indicating (with a corresponding draft of water to each) the various percentages of reserve buoyancy, viz.: 20, 25, 30, and 35 per cent. of such total value as had been assessed by a certain formula, leaving the ship owners to use their own judgment as to the approximately correct amount of reserve buoyancy which should be retained to insure safe navigation.

By this method of assessment a line was drawn parallel to the keel at the height of the molded depth at side at the lowest point in the sheer and the external displacement of this portion of the vessel was set down as the principal item to which were subsequently added:

Displacement due to the sheer of the vessel,
" " " " round of beam, and,
" " " " thickness of the deck;

the whole, representing strictly the main structural parts of the ship, being reduced to tons of 100 cubic feet for the sake of convenience in dealing with the figures.

The next item dealt with the erections or superstructures on the deck proper; and, after taking into consideration their extent, height, and efficiency from a structural point of view, each was gradually but systematically reduced by means of ratios until their estimated intrinsic value bore a proportion which seldom exceeded 40 per cent. of their actual displacement. This process of assessing the value of erections was a delicate one no doubt, and, although it may be said to have had the merit of being uniform throughout, its weakness laid in the fact that it was based on an arbitrary rule. The same remark may be applied to that portion of the present freeboard tables relating to erections on deck; and a reference to the *Explanatory Notes on the Application of the Freeboard Tables*, issued by the British Board of Trade, only serves to intensify the complexity of those tables and to additionally prove the difficulties which were met with in dealing with this important question.

One thing, however, appears to be certain, viz., that the arguments in favor of reserve buoyancy as a primary factor were sound; and that although an absolutely correct method of determining its proportions for every vessel is admittedly not provided for in the tables under discussion, yet the principle has been recognized and a rule has been devised to approximate its relation to the total volume below water. How far that object has been attained is extremely doubtful. The approximate method given by the Board of Trade to represent the displacements up to and including the upper surface of the tonnage deck is based upon the coefficient of fineness; but, inasmuch as said coefficient is one of *internal* instead of *external* capacity, it is easy to understand how errors may unconsciously be introduced into the very basis on which the whole fabric is constructed.

True it is, experience has shown that a fairly constant relation exists between the internal and external capacity, the latter being about 1.15 or 1.17 to 1; but this only applies to vessels built on the ordinary transverse systems, with frames and floors of normal dimensions, and although it is equally true that the tables, in their numerous exceptions as well as in the appendix, contemplate modifications intended to equalize deviations from the ordinary routine, the fact remains that the registered tonnage under deck which plays so important a part in these calculations cannot always be relied upon otherwise than being an official record the strict accuracy of which is seldom if ever challenged on account of its official source. There are many known instances wherein the actual coefficient, as intended for use in the freeboard tables, comes well above .82, which is the maximum percentage indicated in said tables; and as this coefficient should represent accurately the fineness or fullness of form of any given vessel, it follows that if neglected it fails to take into proper consideration one of the principles on which the tables are based. Moreover, these tables, treating this as a block coefficient, do not take into consideration the important fact that such ratio of the whole to the cube of the three principal dimensions, viz., length, breadth, and depth, represents an average or mean. Vessels, and especially those intended almost exclusively for freight-carrying purposes, differ very materially as to forms; and in cases wherein the shape of the midship frame is carried far into both the fore and after bodies, ending at the stem and stern with very bluff lines, it is evident that the center of gravity of weight (longitudinal center of buoyancy) being carried much beyond its position than would be the case in vessels of relatively finer forms, the increased distance of the center of that weight from the middle of the vessel's length has a tendency to considerably increase the strains which the combined section area of the material amidships was intended to bear with safety.

A careful study of this question, and the result of comparisons made by the writer some fifteen years ago on more than two hundred vessels of various types, demonstrated that, assuming a series of ships having precisely the same dimensions and with the same rise of floors, a difference of close upon 16 1-2 per cent. could be obtained in their displacement by modifying the lines without altering the midship section; and that being the case, it follows that, according to Lloyd's Rules, whose scantlings are regulated by the addition of the 1-2 girth of the midship frame, the 1-2 beam and the depth, multiplied by the length of the vessel in feet and fractions thereof, any of these vessels when built would present exactly the same aspect as to their capabilities to resist the shearing and hogging strains to which they may be liable in a heavy sea, without reference to "form," although it is evident that the fuller ships when laden, especially with a dead-weight cargo, would suffer most.

It also follows that if the scantlings, as regulated by the above-named rules, are adequate for the fuller ships, they are excessive for the finer ones which are thus unnecessarily penalized by an additional weight of material detrimental to their carrying capacity. On the whole it shows that, in taking a coefficient of fineness as a basis for determining the form of a vessel, it is also necessary to ascertain the position of the longitudinal center of buoyancy relatively to the middle of the vessel's length, as this will affect the efficiency of the sectional area of the material upon which the whole structure depends and which was taken as a standard of strength in framing the tables. This does not appear to have been done, and if it be argued that the coefficient of fineness for freeboard purposes is chiefly intended as a means of approximating the forms of a vessel, in order to further approximate her displacements to the height of the deck to which the freeboard is taken, it is submitted that this is not sufficient for practical purposes, inasmuch as the under deck tonnage of modern built steamers cannot be said to represent a constant relation to their external capacity, and also because said coefficient fails to include in its scope the relative position of weights which control the longitudinal strains to which a ship is liable.

Other items are no doubt opened to criticism also, and it is felt that the considerations which govern the reduction of the original freeboards used in Tables A, B, and D, specially with reference to the superstructures above the tonnage deck, are extremely complicated. Notwithstanding the numerous rules and equally numerous exceptions relating to these, it may be said also that too much latitude is left to the surveyors in determining the percentage of efficiency and corresponding deductions or additions to freeboard which should be made on account of the strength or weakness of these erections; their means of ingress, and the facilities afforded the crew

to enable them to get backwards and forwards from their quarters if not berthed in the bridge house. In other words, it is felt that the present freeboard tables are perhaps unduly complicated for general use and that their application should not be controlled solely, as it is practically at present, by one society's rules, which, however excellent in many respects, are by no means infallible. This absolute recognition of Lloyd's Rules as a permanent standard of structural efficiency for all vessels to which a freeboard may, or must, be assigned to meet certain requirements, is susceptible of placing certain ship owners at a disadvantage, specially when their ships, although quite suitable for the particular service in which they are engaged, do not happen to have been built under the special supervision of the surveyors to Lloyd's Register.

Their existence also had a salutory effect at the time conservative in its views—so much so, indeed, that, tired of the tyranny it exercised for years previous to 1872, the Liverpool ship owners and underwriters founded the *Red Book,* as a check upon its ever increasing demands for more weight. The *Red Book* disappeared in 1885, having been absorbed by its stronger and more wealthy competitor; but the Glasgow builders and owners, fearing a recurrence of their troubles from the monopoly which threatened to again have the upper hand, brought forth the British Corporation, in whose register a good many Clyde-built vessels are classed, as well as several on this side of the Atlantic. The Bureau Veritas, another important international classification society, has held its own ever since 1828, and it must be admitted that the existence of these several societies, outside of Lloyd's Register, has materially contributed to the maintenance of an equitable basis on which ships can be constructed with absolute efficiency and yet without prejudice to either the builders or the owners of the same.

Their existence also had a salutory effect at the time the freeboard tables were framed, for, although Lloyd's tables were adopted officially as a government measure in 1890, they had by that time undergone many modifications in the hope of meeting the severe criticisms to which they gave rise, specially when issued in book form in 1882. A more liberal allowance was made, and under the plea of "adopting a practice ship owners would like to follow," a considerable reduction was made in the freeboards originally published.

All this tends to show that however elaborate the rules for assigning a freeboard as approved by the British Board of Trade may be, their highly scientific clothing covers certain weaknesses which demonstrate that a good deal of the "rule of thumb" had to be resorted to before they could be brought up to their present standard, yet it will no doubt be readily admitted that tentative efforts were most desirable at the beginning and that the complex nature of the problem rendered experiments inevitable. The question now would be to take advantage of the experience gained by the working of the present tables to frame similar ones, or others which might be simplified, and in which the possibility of errors could be eliminated by the adoption of certain rules representing more accurately the various items to be taken into consideration.

It might be impossible, as was found in Great Britain in the case of some vessels actually afloat, to obtain the data requisite for constructing a complete displacement scale from which by deduction the exact ratio of the internal to the external capacity as well as the exact percentage of reserve buoyancy on a given draft of water might be ascertained; and for all such cases previous records of these vessels at sea and the results of practical experience would be sufficient in determining a suitable load line. In the case of either recently built vessels or others under construction where such data is easily accessible, there seems to be no reason why the *external* capacity should not be selected in preference to the tonnage to obtain the coefficient of fineness. This would be strictly accurate, and as the same data employed to arrive at the displacement could be utilized for obtaining the position of the longitudinal center of buoyancy in both the fore and after bodies, this item might be taken into consideration in determining the effect of its position on the probable resistance of the material amidships. Each vessel should be dealt with on her own merits, regardless of the classification society (if any) under whose special supervision she was built, the government adopting standard rules of its own.

Regulations covering the extent, strength, and general efficiency of superstructures for various types of ships should also be made uniform and rigidly enforced, thus reducing to a minimum the discretion of surveyors whose personal opinion might be influenced by local considerations in widely spread districts; and it is believed that if these and probably other suggestions were carefully considered it would not be difficult to arrive at a satisfactory solution of the problem of determining a suitable load line for American-owned ships at least. That a universal load line should prevail for vessels of every nationality is necessary to the interests of shipping in general; both for the sake of the sea-faring community as well as for the protection of ship owners and underwriters, some international congress should be created to deliberate and determine upon the best method on which such load line might be assigned to bring that question on the same level as the tonnage laws.

The necessity of this can be seen at a glance. No vessel, British or otherwise, is allowed to leave a port of the United Kingdom without inspection by a Board of Trade surveyor who may order some of her cargo to be discharged if, in his opinion, that vessel does not comply with the regulations as to freeboard, the same rule applying to the British vessel when leaving a foreign port; but any vessel, if not sailing under the British flag, may return to the same port in what would be considered an overladen condition, or sail from any foreign port with a considerably reduced freeboard and a corresponding increase of dead-weight capacity simply because she is not subject to any definite rule as to a maximum load line. As a single example out of many, a steamer 215 feet long, by 30 feet beam, by 16 feet deep, of about 600 tons net, classed 100 A1 at Lloyd's, sailed repeatedly from Cardiff with coals with a freeboard in accordance with the Board of Trade rules, but when leaving another port (outside the United Kingdom) with sugar or other freight she usually carried between 200 or 300 tons more cargo. Under such circumstances it must be assumed that either the freeboard assigned by the Board of Trade was excessive or that the vessel was sadly overladen; but be that as it may, the fact that vessels of the same

type and same dimensions but of different nationalities may be allowed to load under peculiar conditions must be regarded as a glaring injustice to the owner whose vessel's draft of water is limited by law, while at the same time the excess in the loading of the "free" ship must be a source of danger to the lives of those on board and to the safety of the valuable cargo she may be carrying, if the freeboard tables approved by the British government are of any account.

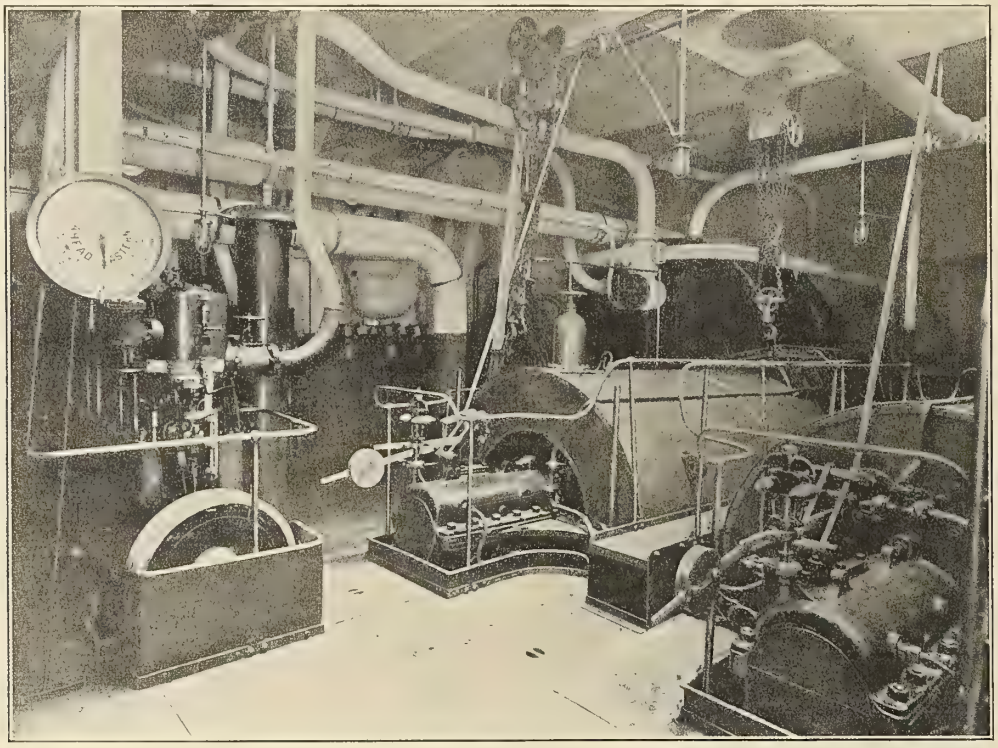
This country does not possess any definite rule on which a load line can be based, yet it owns about 4,000,000 tons of shipping (an increase of more than 200,000 tons over last year), and this would therefore seem to be more than a sufficient reason for enacting some suitable law to regulate the loading of such an important and (let us hope) ever increasing mercantile marine.

According to a weekly shipping paper recently published, it was stated that Germany appears to be in favor of adopting some regulations for the establishment of an international law of load line. No doubt other maritime countries would feel likewise inclined in the hope of doing away with the differences existing between the maritime nations of the commercial world; and although it can scarcely be expected that an understanding could be arrived at without much time and discussion, yet if such desirable object were ultimately attained the shipping interests of this country would be placed on an equal footing with those of other nations and we might be proud some day of having contributed in no small degree in the saving of many lives and much valuable property, both of which are essential to our own welfare in years to come. H. W.

TURBINE STEAMERS FOR THE IRISH CHANNEL.

Additional facts concerning the four new steamers built for the Midland Railway Company and mentioned in the September Marine Engineering are now obtainable. It will be remembered that the *Antrim* and *Donegal* are fitted with the usual twin-screw reciprocating engine. In this connection there was a mistake in the dimensions of the cylinders in the September issue. These engines are of the triple-expansion, four-cylinder type with cylinders 23, 36, 42, and 42 inches by 30 inches stroke.

The *Londonderry* and *Manxman* have compound Parsons turbines, consisting of one high-pressure on a central shaft and a low-pressure on each of the side shafts. The boiler equipment of all four vessels is the same and comprises the following: Two double-end and one single-end Scotch boilers, 22 feet and 11 feet 6 inches long respectively. The diameter of all is 15 feet 7 inches. There are six 47-inch furnaces in the double-end and three 47-inch furnaces in each of the single-end boilers. The grate bars are 6 feet 6 inches long, and the total heating surface is 12,461 square feet, and the area of the grate is 402 square feet. The boilers for the *Londonderry* are built for a working pressure of 150 pounds, while those for the other three ships are designed for 200 pounds boiler pressure. This difference in working pressure permits of a saving of 70 tons in the weight of the *Londonderry's* boilers. The total weight of machinery in the *Antrim* and *Donegal* is 730 tons, made out as follows: Boilers with water, 460 tons; engines, 210 tons; shafting, 60 tons. In the *Londonderry* the total machinery weight is 575 tons, which



VIEW IN THE ENGINE ROOM OF THE TRIPLE-SCREW TURBINE STEAMER MANXMAN.

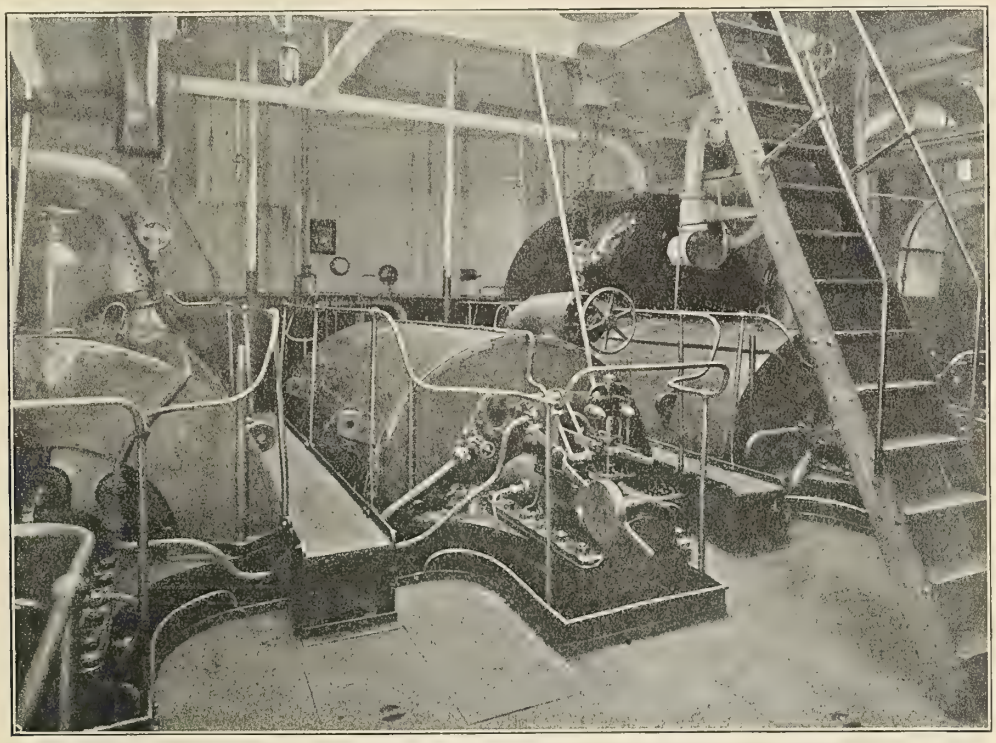
includes 390 tons for boilers and water, 160 tons for turbine engines, and 25 tons for shafting; for, on account of the higher speed of revolution, much lighter shafting can be used.

All four vessels were designed for a contract sustained speed on 6-hour trial of 20 knots. This was exceeded in each case, and the trials show decidedly in favor of the turbine vessels.

TRIAL SPEED.

	Antrim.	London-derry.
With two double-end boilers mean of six-hour trial, knots	20.6	21.6
Maximum speed for measured mile with two double-end boilers, knots	21.0	21.9
Maximum speed for measured mile with all boilers, knots	21.9	22 27

steel plate shell condensers are used on the reciprocating engines. There are two sets of Weir duplex air pumps 7 1-2 and 20 inches by 16 inches. The condensing machinery on the *Londonderry* consists of two steel plate condensers, into which the exhaust from the two low-pressure turbines is led, and three baffle plates are fitted to improve the circulation of the steam. To get the greatest amount of vacuum, so necessary for steam turbine machinery, there are two air pumps. One, termed the wet air pump, placed close to the condenser, is of the usual Weir duplex type; the other, the dry air pump, consists of a cylinder 20 inches in diameter placed on top of the circulating water engine cylinder, and has a stroke of 9 inches. This draws from an air chamber on the suction side of the wet air pump and both discharge to Weir float tanks, into which the condenser drains naturally.



ENGINE ROOM OF THE TURBINE STEAMER MANXMAN, SHOWING THE CENTRAL HIGH-PRESSURE AND THE TWO SIDE LOW-PRESSURE PARSONS TURBINES.

In comparing the speed of the two turbine vessels, the *Londonderry* and *Manxman,* it is interesting to note that the higher boiler pressure of the latter, and resulting increased boiler and engine weight, is more than offset by the increased speed of 3-4 of a knot, as shown in the following table:

MAXIMUM SPEED TRIALS.

	London-derry.	Manxman.
Steam pressure at boilers, lbs.	150	200
" " " H. P. receiver, lbs.	135	180
Vacuum, inches	28	29
Revolutions per minute, center shaft	670	530
" " " side shafts	750	610
Speed, knots	22.27	23

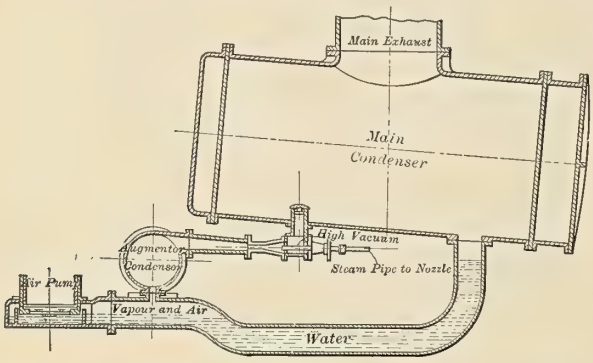
The usual forms of independent air pumps and separate

The vacuum on the *Manxman* was obtained by a somewhat similar arrangement of condensing apparatus, which is shown in the accompanying drawing. It consists of a "vacuum augmenter." The air pump is placed about 3 feet below the condenser, and the connecting pipe forms a water leg. From another point in the bottom of the condenser shell is taken a pipe in which is placed a steam nozzle to improve the vacuum in the condenser. This nozzle discharges to a second condenser, which in turn discharges into the main air pump suction. It is found that the amount of steam used by the nozzle was but 1 1-2 per cent. that used by the turbine at full load. The auxiliary condenser is supplied with circulating water in parallel with the main condenser.

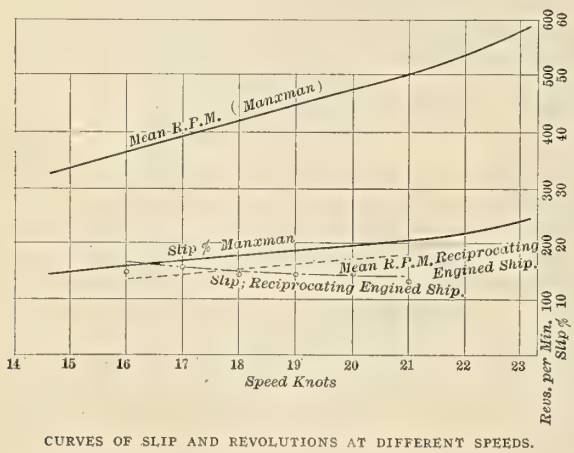
The slip of the reciprocating engine vessel was very satisfactory, amounting to only 13.6 to 15 per cent., the former at the highest speed, namely, 21 knots. The

curve is here reproduced, showing the slip at different speeds for the *Manxman.*

It is stated that the four vessels made very satisfactory trials, and that practically no vibration was noticed on the turbine vessels. For the above facts, as well as acompanying illustrations, we are indebted to London *Engineering.*



MAIN AND AUGMENTER CONDENSERS FOR OBTAINING HIGH VACUUM.


Mean R.P.M. (Manxman)
Slip % Manxman
Mean R.P.M. Reciprocating Engined Ship.
Slip, Reciprocating Engined Ship.
14 15 16 17 18 19 20 21 22 23
Speed Knots
Revs. per Min. 100 200 300 400 500 600
Slip % 10 20 30 40 50 60

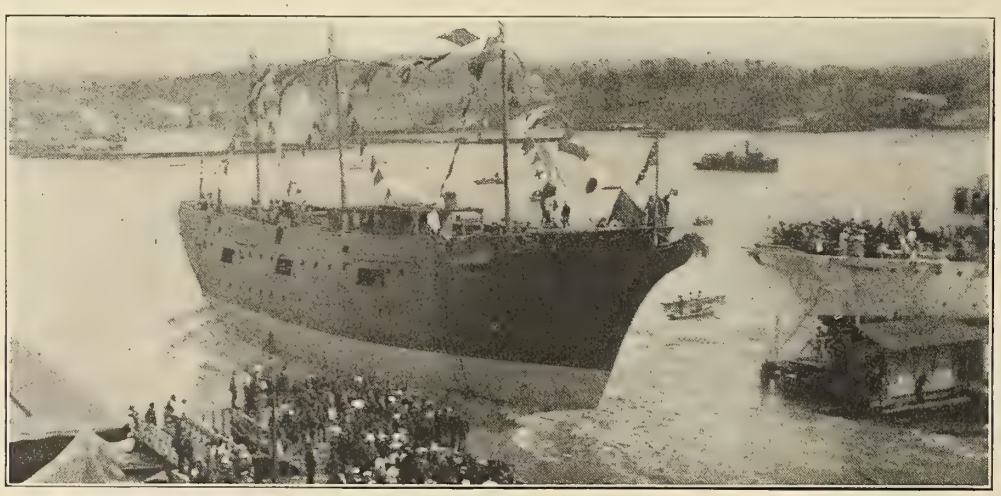
CURVES OF SLIP AND REVOLUTIONS AT DIFFERENT SPEEDS.

United States Training Ship Intrepid.

Mare Island Navy Yard was the scene of much interest on October 8, when the new United States steel training ship *Intrepid* was launched. The *Intrepid* has been designed as a sailing vessel in recognition of the doctrine, now generally conceded by naval officers, that the best school for twentieth century men-of-warsmen is a sailing ship. The *Intrepid* has a bark rig and is of the following dimensions:

Length on board load water line.....176 ft. 5 ins.
Beam, extreme ..... 45 ft. 7 3-4 ins.
Mean normal draft..... 16 ft. 5 1-4 ins.
Corresponding displacement ..... 1,800 tons

The hull is built of steel throughout. While the vessel is to be propelled by sail, there is an auxiliary engine in the boiler room in which is a Scotch boiler for supplying steam to auxiliaries, which include electric light plant, evaporators for supplying fresh water, drainage and fire pumps, and capstan and windlasses. The battery consists of six 4-inch rapid-fire guns; four 6-pounders; two 1-pounders, and two Colt and machine guns. In addition to a commanding officer, the *Intrepid* will carry 9 ward room officers, 6 warrant officers, and 320 men.



UNITED STATES TRAINING SHIP INTREPID, LAUNCHED FROM THE MARE ISLAND NAVY YARD.

Cost of Government-Built War Ships.

Rear-Admiral W. L. Capps, chief constructor of the navy, in his annual report, dealing with the work on the battleship *Connecticut,* building at the New York yard, says that despite every effort to reduce the cost of this the first battleship to be constructed in a navy yard to the most economical basis, it can hardly be hoped that the work will be done as cheaply as when performed in private shipbuilding yards, whose rates of pay for nine hours' work are, in many cases, less than those being paid for eight hours' work at the navy yard.

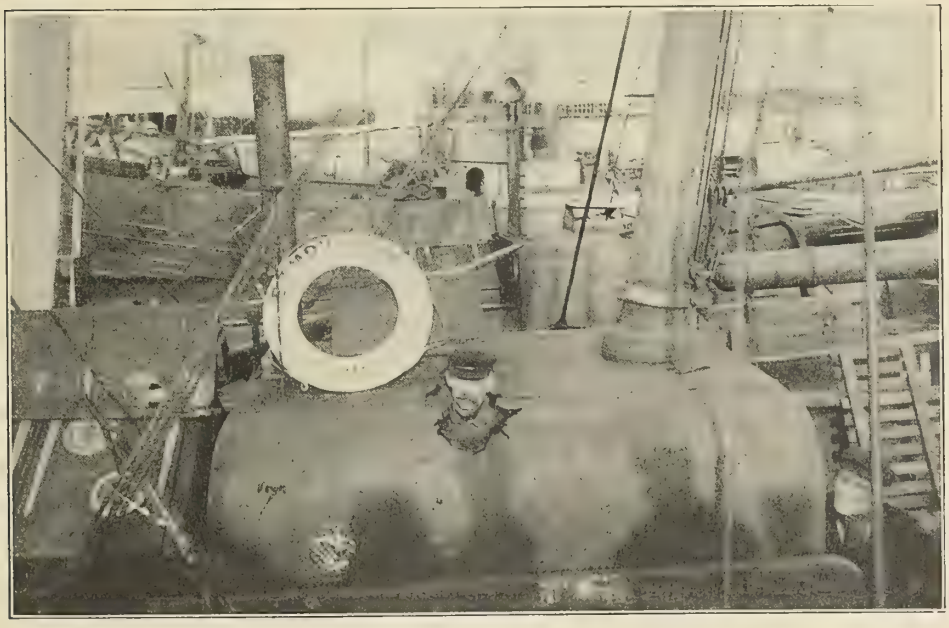
"It may also be noted," he says, "that private ship yards do not pay their per diem employees for holidays or when on leave, whereas a very large proportion of per diem employees on the *Connecticut* receive pay for fifteen days' leave and seven public holidays during the calendar year, without any work being done in return."

THE RUSSIAN NORTH SEA INCIDENT.

Interest in the events of the Russo-Japanese war in the far east is suspended on account of the meeting of the Russian squadron, leaving the Baltic sea for the seat of war, with the Hull fishing fleet in the North sea. The daily papers have given such full accounts of this outrage that it is only necessary to here mention briefly the reported facts of the incident, which resulted in the sinking of one trawler, the damage of two other boats, as shown in the accompanying illustrations, and the killing of two officers in the fishing fleet.

About 1 o'clock on the morning of October 21 the two Hull fishing fleets, called the Gamecock fleet and the Northern fleet, were fishing about 220 miles northeast of Spurmhead, the weather at the time being slightly hazy. The crews of the fleet noticed the outlines of what appeared to be war vessels and torpedo boats, and soon after were dazzled by search lights from these vessels. This was immediately followed by opening fire on the part of the war vessels upon the fishing fleet, and the bombardment lasted for twenty minutes. Fortunately the loss on the fishing fleet was

THE FISHING TRAWLERS MINO AND MOULMEIN.

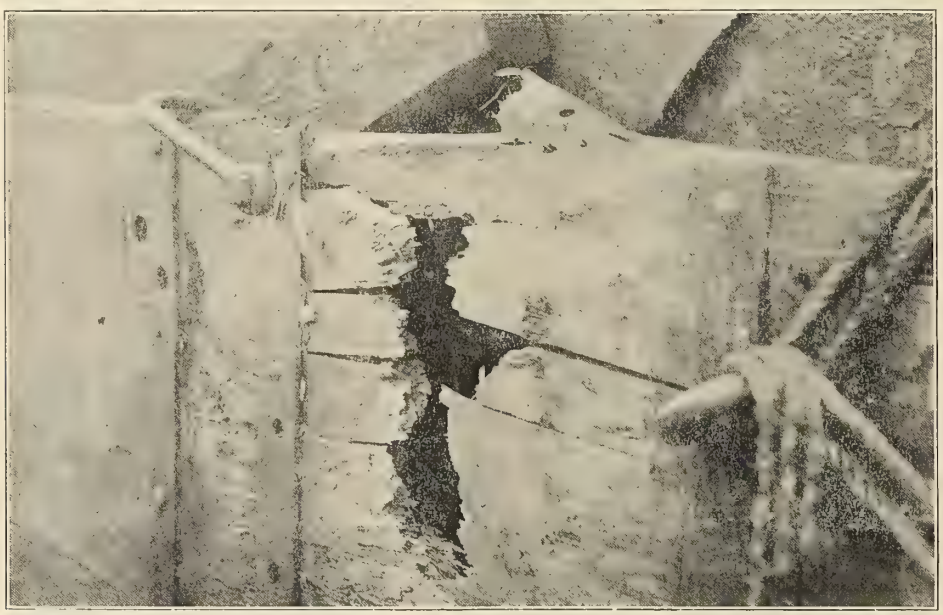


THE TRAWLER MOULMEIN OF THE HULL FISHING FLEET, STRUCK BY SHELLS FROM THE RUSSIAN FLEET IN THE NORTH SEA.

[Photographs by James Fisher, Hull, Eng.]

very small, considering the number and size of the shots fired, but the trawler *Crane* was sunk, two of her crew killed, and several injured. The *Moulmein* was struck by round shot, as shown in the illustration, and the *Mino* fared even worse, as she had eight holes in her side plating, fortunately above the water line.

The firing ceased as suddenly as it had started, and the Russian fleet proceeded on its course. The excitement which followed the report of this incident in England is well known, as is also the delay in receiving any adequate explanation from the Russian admiral, who proceeded to Portugal before reporting. His report was as curious as the incident was tragic. He states that he had seen Japanese torpedo boats and had fired upon them. While awaiting the convening of the peace conference, called to establish the blame for this tragedy, the gist of the matter appears to be that the Russians, sailing from home with new and untried ships and crews, were so overwrought by fear or excitement of a midnight attack, that they mistook the peaceful fishing fleet for a flotilla of Japanese torpedo boats, and believed their only salvation was to sink them on the spot.



RESULT OF RUSSIAN SHELLS ON THE TRAWLER MOULMEIN. THIS BOAT WAS STRUCK IN MANY PLACES.

Engineering Positions.—The United States Civil Service Commission announces that in January examinations will be held for the following engineering positions: On January 4 and 5, to fill three vacancies of civil engineer student in Department of Agriculture at not exceeding $50 per month each; on January 18 and 19, an examination for the position of irrigating engineer in connection with the irrigating and dranage investigations in the office of the Experimental Stations, Department of Agriculture, at a salary of from $1,500 to $2,000 per year. Further particulars and application forms may be had by applying to the commission, Washington, D. C.

NAVAL ARCHITECTURE.—II.*

BY SIR WILLIAM H. WHITE, K.C.B., F.R.S.

BRITISH MERCHANT SHIPPING IN 1904.

The growth of the British mercantile marine, during the last ten years, has been both great and continuous, as will be seen from Table 1, furnished by the authorities of that great organization, Lloyd's Register of British and Foreign Shipbuilding.

In 1903 there were launched 697 vessels of nearly 1,200,000 gross tonnage, and 41 war ships of 152,000 tons displacement. At the close of 1902 the British register contained 5,037 steamers of nearly 4,500,000 tons, and 2,384 iron steamers of 1,120,000 tons. The total for the British empire was 8,553 steamers of 14,193,000 tons; all other maritime countries combined owning 9,228 steamers of less than 13 million tons. Including sailing ships the total for the British empire was 11,134 vessels aggregating over 15 million tons; all other maritime countries combined owned 18,809 ships, with an aggregate tonnage of 17,637,000 tons. It is universally agreed that in economy of first cost, and in speed of construction, British shipbuilding has a considerable advantage, due, no doubt, chiefly to the fact that Great Britain took the lead in the introduction of both iron and steam ships, and has had the advantage resulting from the training of two generations of skilled workers, and of the enterprise of ship owners and shipbuilders.

The growth in the size of individual ships during the last ten years has been most remarkable. It has been stated that in 1894 there was building only one ship of 10,000 tons, which was launched in the following year. Table 2 has been prepared by Lloyd's Register, and gives the names of vessels of over 10,000 tons (gross) launched during the years 1894 to 1903.

At the end of 1903 the largest vessel afloat was the

*Paper read before the International Engineering Congress, St. Louis, Mo., October 8, 1904.

TABLE 1.—VESSELS BUILDING IN THE UNITED KINGDOM ON THE 31ST MARCH IN EACH YEAR FROM 1894 TO 1904, INCLUSIVE.

(*War ships not included.*)

Year.	Steam.		Sail.		Total.	
	Number.	Tons (gross).	Number	Tons (gross).	Number.	Tons (gross).
1894...	346	663,396	68	61,812	414	725 208
1895....	310	628,605	46	27,713	356	656.318
1896....	341	736,472	59	32,792	400	769.264
1897....	388	810,439	40	18,042	428	828,481
1898....	579	1,181,036	27	4,085	606	1,185,121
1899....	568	1,382,289	29	3,426	597	1,385.715
1900	511	1,249,099	43	11,323	554	1,260,422
1901....	415	1,294,163	29	8 953	444	1,303.116
1902....	401	1,213,504	30	26,840	431	1,240.344
1903....	382	963.365	43	11,321	425	974.686
1904 ...	353	973 511	45	15.153	398	988,664

Baltic, of nearly 24,000 tons gross tonnage, which commenced her service in June, 1904. It is unnecessary here to explain the economic advantages attaching to increase in the size of ships, or its effect upon the cost of over sea transport. But it may be interesting to state that, whereas in 1890, the average gross tonnage of British steamers (exceeding 100 tons) was 1,570 tons, in 1902 it was 2,200 tons. This average includes a large number of yachts, river and coasting steamers, and other vessels of less than 200 tons gross. In Table 3, prepared by Lloyd's Register, the size of merchant and other vessels exclusive of war ships launched in the United Kingdom during 1903 is indicated.

TABLE 2.

Name.	Tonnage.	Year.	Name.	Tonnage.	Year.
Georgic.....	10,077	1895	*Celtic*.....	20.904	1901
Pennsylvania...	13.333	1896	*Minnetonka*.....	13,398	1901
Cymric.....	13,096	1897	*Walmer Castle*...	12'546	1901
Briton.....	10,248	1897	*Noordam*.....	12,531	1901
Medic.....	11,985	1898	*Rijordam*.....	12,527	1901
Afric.....	11,948	1898	*Athenic*.....	12,234	1901
Romanic.....	11,394	1898	*Haverford*.....	11,635	1901
Statendam.....	10,491	1898	*Merion*.....	11,621	1901
Oceanic.	17,274	1899	*Cedric*.....	21,035	1902
Ivernia.....	14,058	1899	*Arabic*.....	15,801	1902
Saxonia.....	14,281	1899	*Carpathia*	13.564	1902
Minneapolis....	13.401	1899	*Cretic*.....	13.518	1902
Saxon.....	12.385	1899	*Corinthic*.....	12,231	1902
Persic.....	11.973	1899	*Ionic*.....	12.232	1902
Winifredian....	10,405	1899	*Hellig Olav*.....	10,085	1902
Bavarian.....	10.387	1899	*Baltic*.....	24,000	1903
Minnehaha.....	13,403	1900	*Republic*.....	15.378	1903
Suevic.....	12,500	1900	*Kenilworth Castle*.....	12,975	1903
Runic.....	12 482	1900	*Armadale Castle.*	12,973	1903
Canopic...	12.097	1900	*Slavonia*.....	10.606	1903
Vaderland.....	12,018	1900	*Macedonia*.....	10.512	1903
Zeeland.....	11.905	1900	*Marmora*.....	10.509	1903
Tunisian.....	10.576	1900	*United States*.....	10,095	1903
Devonian.....	10.418	1900			

The mercantile fleets of the world, at the end of 1902, included 84 steel steamers of 10,000 tons and upward. Of these, 39 were owned by the United Kingdom, 26 belonged to Germany, 9 to the United States, and the remainder to France, Holland, and Denmark. At the same date there were 145 vessels of 7,000 to 10,000 tons, 109 belonging to the United Kingdom, 22 to Germany, and 7 to the United States.

The great cargo steamers, with enormous carrying capacity, can be profitably worked at low rates of freight, and enable transport over sea to be conducted with remarkable economy. In the writer's presidential address

TABLE 3.

Tonnage.	Steam.	Sail.	Tonnage.	Steam.	Sail.
Under 50 tons.....	5	5	6,000 to 6.999 tons..	9	..
50 to 99 tons.....	48	2	7 000 to 7,999 tons..	12	..
100 to 199 tons.....	116	31	8,000 to 8.999 tons..	1	..
200 to 499 tons.....	113	17	9,000 to 9,999 tons.	3	..
500 to 999 tons.....	45	5	10,000 to 11,999 tons.	3	..
1 000 to 1,999 tons..	92	5	12,000 to 14,999 tons.	2	..
2,000 to 2,999 tons..	52	1	15,000 tons and above.....	4	..
3.000 to 3,999 tons..	77	..			
4 000 to 4,999 tons..	45	..	Total...	632	65
5,000 to 5,999 tons..	5	..			

at the Institution of Civil Engineers he gave many illustrations of these facts, showing that the cost of fuel per thousand ton-miles has been reduced to 2 1-2 to 3 pence, and that in the White Star steamer *Suevic* an expenditure of about 3 shillings on coal drives a ton weight from England to Australia. The *Ivernia* and *Saxonia* of the Cunard line exceed 20,000 tons in displacement, and steam 15 1-2 knots on 140 tons of coal a day. The cargo steamer *Monarch,* carrying 11,600 tons, dead weight, averaged over 11 knots on two Atlantic voyages, burning about 48 tons per day. The outward voyage was in ballast; on the homeward she was fully laden. Quick despatch in loading and discharging these enormous cargoes is essential, as the stay in port must be minimized if the best economic results are to be obtained. By the aid of mechanical lifting appliances a mixed cargo of 11,000 tons dead weight can be discharged in 66 hours. In no department of ship equipment has greater advance been made than in the device and construction of these lifting appliances. Careful organization is required also for the collection and warehousing of the cargo, in order to shorten the period of stay in port. As an example of what can be done, it may be stated that an excellent authority recently gave 25 to 30 shillings per ton as the cost of conveying ordinary cargo from the United Kingdom to Bombay, which is about 1-35th of the average cost of transport of goods by railway in the United Kingdom.

On June 30, 1904, there were 361 merchant ships under construction in the United Kingdom. Of these, 132 were less than 1,000 tons, 70 from 1,000 to 3,000 tons, 137 from 3,000 to 6,000 tons, 11 from 6,000 to 9,000 tons, 4 from 9,000 to 12,000 tons, and 7 more than 15,000. It will be seen, therefore, that while the average dimensions of ships are increasing and a larger number of ships are built of extreme dimensions and tonnage, use can still be found for great numbers of cargo steamers of moderate size. The supreme position of the British mercantile marine is due chiefly to its development of cargo steamers, and (to quote the writer's own words) "the largest share of the work of the world in over-sea transport is still done by the much despised 'tramp' steamer." By close study of requirements, and successive improvements made by shipbuilders, engineers, and ship owners, wonderfully economical results have been achieved. For example, a vessel about 360 feet long, 47 feet broad, 30 feet deep, and drawing 24 to 25 feet when loaded, can carry 6,500 tons dead weight, and steam at 11 knots with a consumption of 27 tons of coal *per diem.* The cost of fuel per thousand ton-miles is less than 3 pence, and under the present conditions of the shipbuilding trade the first cost would be about £40,000. When

such economy is realized in steamships, which secure greater speed and regularity of service, it is no wonder that they are gaining upon sailing ships even for the longest ocean voyages.

Sailing ships have been continuously diminishing in importance during the last ten years. In 1903 only 65 sailing vessels of 25,000 tons gross were launched in the United Kingdom. Under modern conditions steamships are reckoned, for commercial purposes, as equal to four or five times their tonnage in sailing ships; and as the mercantile marine of the United Kingdom contains so small a proportion of sailing vessels, in comparisons of efficiency or carrying capacity, these circumstances must not be overlooked. There is a keen desire on the part of British ship owners to keep abreast of the necessities of traffic, and to secure the greatest possible economy, which leads them to substitute new for old ships long before the latter are worn out. In 1902, for example, about 320,000 tons of British ships were sold to foreign owners as against purchases of 65,000 tons. The sailing tonnage of the United Kingdom decreased by about 92,000 tons in 1903, while the steam tonnage increased by 497,000 tons, and the net increase of British tonnage, during 1903, amounted to 405,000 tons. The net increase of the world's tonnage in 1903 was 1,402,000 tons, steam tonnage being increased by 1,545,000 tons, while sailing tonnage was diminished by 143,000 tons.

The *Baltic* is the first modern steamship exceeding the *Great Eastern* in length between perpendiculars, displacement, and tonnage, but she is inferior to that ship in breadth and molded depth. She is 710 feet between perpendiculars, and about 726 feet in length over all, 75 feet beam, 49 feet molded depth, with engines developing 13,000 to 14,000 I. H. P. and a speed of 16 to 17 knots on service. At 32-foot draft she displaces 34,000 tons, and if depth of water were available, she could be safely loaded to 37 or 38 feet, the displacement being then over 40,000 tons. She can carry 3,000 passengers in addition to her crew of 350 officers and men, and her cargo capacity is enormous. To deal rapidly with this cargo she is fitted with very powerful and numerous lifting appliances. In this latest example of the intermediate class of passenger and cargo steamer with moderate speed is to be found an epitome of the progress made in shipbuilding and engineering during the half century which has elapsed since Brunel commenced his studies for the *Great Eastern*, and the genius of the great engineer stands out the more clearly as the comparison between the two vessels is completed. Considering the date and circumstances of her construction, the *Great Eastern* is still the most remarkable vessel ever completed, although she is no longer the largest.

Hitherto the intermediate class of passenger and cargo steamer has not exceeded 15 to 16 1-2 knots in speed, but in the *Coronia* of the Cunard line, launched in July, 1904, a new departure has been made, and a service speed of 18 knots has been decided upon. Her dimensions are not so great as those of the *Baltic*. She is about 48 feet shorter and 3 feet narrower, her gross tonnage is 3,000 tons less, and her displacement at 32 feet about 30,000 tons, 4,000 tons less than that of the *Baltic*. Her total accommodation is for 2,650 passengers and 450 crew. The engines are to develop over 20,000 I. H. P., or fully 50 per cent. more than the power in the Baltic. The dead weight capacity is 12,000 tons, considerably less than that of the *Baltic*. A sister ship of the same size, but with turbine engines, is also in hand. They are interesting vessels, standing midway between the previous intermediate steamers and the *Oceanic* of the White Star line, which is about 27 feet longer, 5 feet narrower, and about 2,000 tons less displacement, but has engines of one-third greater power, and a sea speed of nearly 21 knots. The *Oceanic* has quite exceptional cargo capacity for an Atlantic liner, but is necessarily inferior in that respect to intermediate steamer (like the *Cedric*) of about the same dimensions with half the engine power, and 4 to 5 knots slower.

The *Kaiser Wilhelm II.* slightly exceeds the *Oceanic* in dimensions, but is of much greater gross tonnage (20,000 against 17,270 tons). Her load draft is less, but at the same draft the two vessels would have approximately equal displacements, say about 26,000 tons at 29 1-2 feet. The German ship has engines of 50 per cent. greater power and is from 2 1-2 to 3 knots faster. Her dead weight capacity is, therefore, much less, while her coal consumption is much greater, and she can carry very little cargo as compared with the *Oceanic*.

These are interesting illustrations of the widely different distributions required with practically the same displacement in order to fulfil varying conditions of speed and carrying power or accommodation. To the naval architect the close study and careful analysis of examples in past practice is full of interest, and conducive to progress in later designs.

The designs of the new Cunard steamers, which are to be capable of maintaining a speed exceeding that of the fastest German ships by at least a knot, furnish the latest illustration of the great increase in size and cost which accompanies increase in speed. They will be 760 feet long between perpendiculars, 88 feet broad, and over 60 feet molded depth. Accommodations will be provided for nearly 3,000 persons. To secure the intended speed the engine power will have to be about 70 per cent. greater than that of the *Kaiser Wilhelm II.*, and the corresponding increase in coal consumption will make such large demands on the dead weight capacity that only a very moderate amount of cargo will be carried. In the agreement with the British government it is contemplated that each of the two ships will cost £1,300,000. The use of steam turbines instead of reciprocating engines, and of four shafts and propellers, involves an experiment of great novelty; but it has been undertaken after full enquiry, and promises to be successful, while its potential advantages are very considerable.

SPECIAL CLASSES OF CARGO STEAMERS.

The last ten years have been marked by considerable specialization in designs for steamers, in order to adapt them for the conveyance of various descriptions of cargo, or to secure other advantages. Side by side with this specialization has proceeded the development of the tramp steamer, which seeks for cargoes in all quarters, and generally manages to accommodate any cargo that offers.

Oil-Tank Steamers.—Among these special types oil-tank steamers stand prominent. Eighteen years ago only ten steamers carried oil in bulk on over-sea voyages, and these vessels were of moderate size, not exceeding 240

feet in length and 1,500 tons (gross). In 1902 there were nearly 200 tank steamers, many of large size. The largest is 512 feet long, of 21,000 tons load displacement, fitted to carry 11,000 tons of oil in 16 tanks, and capable of carrying 12,500 tons dead weight. The maximum speed is 14 knots. In the design of these vessels difficult problems have to be solved in regard to subdivision, stability and strength of structure, in consequence of their liquid cargoes. In working them, remarkable results have been achieved, in the direction of adaptability for general cargoes when oil is not carried.

Meat Carriers.—These steamers form another group which has been greatly increased in size and number. About 160 vessels of this class are now employed in the carriage of frozen meat. They are fitted with powerful refrigerators, and built with elaborate arrangements for the insulation and ventilation of storage chambers. The largest vessels approach 500 feet in length, with dead-weight capacity of 10,000 tons, and each can carry 100,000 carcases. It is estimated that in the aggregate this section of the mercantile marine can carry from 9 million to 10 million carcases.

Ore Carriers.—Vessels of this type, of great size, have also been built with special means for shipping and discharging cargoes. The *Grangesburg* is the most notable of these, having been completed in 1903. She is of the turret type, 440 feet long, 10 1-2 knots speed, with about 10,000 tons dead-weight capacity. She has 24 derricks carried on 7 pairs of masts, and 12 large hatchways. The whole cargo can be discharged in 35 hours. And it is stated that she will carry and discharge over 200,000 tons of ore per annum in her service between Sweden and Rotterdam.

Cable-Laying Steamers.—These steamers date from 1874, when the *Faraday* was specially built for this service. Her length is 360 feet, breadth 52 feet, and gross tonnage 4,900 tons. She can carry 4,300 tons cable, and nearly 1,600 tons of coal and stores on 26 feet draft, the speed being 8 to 9 knots. The largest cable-laying ship on service at present is the *Colonia* (built in 1902), her length being 487 feet, breadth 56 feet, 8,000 tons gross, with speed of 12 to 13 knots. On her first voyage, while laying the Pacific cable, she carried over 3,500 miles of cable, weighing nearly 7,700 tons, besides coal and stores, on 26 feet draft. On the voyage she steamed over 3,400 miles and consumed nearly 9,000 tons of coal in 5 months and 10 days. The cable was paid out at the rate of 210 miles per day, the maximum depth of water on the route being 3,400 fathoms.

Turret-Type Steamers.—Of the many special forms of cargo steamers proposed or built in recent years the turret type originated by Messrs. Doxford has found most favor; that firm has constructed a hundred ships, and similar vessels have been built by other ship yards. The latest for general trade is 390 feet long, 5,500 tons gross, and carries nearly 9,000 tons (dead weight) on 24 feet draft at 10 knots, with less than 2,000 horse power. The American whaleback is the progenitor of the turret type.

Single-Decked Steamers.—Vessels of this type of large size have also been recently constructed, special arrangements being made to ensure rigidity in the structures. Vessels of this class carrying 6,000 tons dead weight are on service, and others capable of carrying 12,000 tons have been designed but not yet built.

MATERIALS AND METHODS OF CONSTRUCTION IN 1904.

Up to the present time mild steel holds its own, and there is no marked or general desire to use stronger steel, or to introduce other materials. Experiments made under the writer's direction more than 25 years ago showed that it was possible to obtain steel plates, bars, and rivets having an ultimate tensile strength of 38 to 40 tons per square inch, with good ductility and satisfactory working qualities, if it were found desirable to use such material; but hitherto considerations of durability and stiffness have determined the lower limit of scantlings in most ships, and mild steel has met all requirements. As dimensions and engine powers of war ships have been increased, however, recourse has been had to stronger steel, beginning with torpedo boat destroyers. Similar material has also been specified by the writer for important portions of the structures of large war ships since 1898. In small cruisers it has been extensively used. With this stronger material it is found desirable to drill the holes, but no other special treatment is necessary. The gain in strength, measured by the comparative elastic limits, is from 20 to 25 per cent. over that of mild steel in the material which has so far been used by the British admiralty. It is most important, in specifying for the stronger steel, to define the elastic limit, and to ensure its existence by suitable tests, if full advantage is to be secured.

Admiralty practice has always left manufacturers free in regard to the chemical composition of the material; but the use of open-hearth steel (either acid or basic) is insisted upon for all important parts of the structures of ships. Recent experiments have shown that, so far as plates and bars are concerned, it would be possible, with certain qualities of nickel steel, to obtain still greater strength with good working qualities. It does not appear, however, that proof has been given hitherto that rivet steel of the same quality could be readily worked, or that entirely satisfactory joints could be made in the combinations of plating forming the shells and decks of ships. This is a most important point, and is sometimes overlooked in recommendations of the use of material of high tensile strength. When stronger steel is used, modified structural arrangements are undoubtedly of great importance; because, as the thicknesses of plates and bars are reduced, there is a greater liability to buckling under compressive strains. As regards corrosion, the use of high percentages of nickel would probably furnish the necessary durability, even for very thin plates; but, with reduced scantlings, the provision for ready means of access for examination, cleaning, and painting, are obviously of great importance. The danger of failure by buckling has been shown to be considerable (unless met by proper structural arrangements and stiffening) in many light draft vessels when making over-sea passages to their regular stations. In later years, further illustrations of the necessity for precaution have been afforded in torpedo boat destroyers. It need hardly be said that recognized principles of construction make it obvious that, in order to secure the best association of lightness

and strength, stiffness should be obtained wherever possible by suitable structural supports to thin plates rather than by increased thicknesses in the plates themselves. In many instances, however, this fundamental principle of construction is overlooked, and unnecessarily heavy scantlings are insisted upon, or unwise additions to structure made.

(To be continued.)

Moving Troops in the Philippines.

Uncle Sam's plan of moving a regiment of soldiers from one island to another in the Philippine archipelago is quite perfect. The regiment destined to embark for new territory is first assembled on the beach near the point of embarcation, where arms are stacked and the baggage of each company is made ready to put on board the lighters. After this is safely shipped, the soldiers board the same boats. The work is done under the general supervision of the quartermaster. All the baggage is turned over to him for transportation and proper receipts taken. Natives are in the employ of the quartermaster's department to handle the baggage while the soldiers guard the property. The twelve companies, band, and non-commissioned staff of a regiment can, under the present arrangement, be gotten aboard a transport from the shore in a day very easily. Formerly there was much delay and annoyance due to lack of lighters, tugs to haul them and proper transportation facilities.

There is always fun when the soldiers take to the lighters or small boats on the sandy beaches. The surf usually runs high and all at least get their feet wet. Sometimes the row boats are used to bridge over the space from dry land to the lighters; sometimes the boats are used as ferries. There have been very few drowning accidents. The soldier is required to remove his equipment, so that in the event of the boat sinking he would not be taken down by its weight. Many of the lighters are only native craft, but they hold many soldiers, one or more companies finding room with some of their baggage on a single boat. Once on the lighter the rest is easy as the tug boat tows the lighter to the sides of the big transports.

Each soldier is assigned a bunk on board, and the transport weighs anchor and steams away, but before we can land again we have to touch at Marivalles, the quarantine station near Manila, and be fumigated.

THE UNITED STATES BATTLESHIP OHIO ON TRIAL, SHOWING ENORMOUS BOW WAVE.

[Photograph copyright, 1904, by G. o. P. Pitkin.]

Clothes are removed and tagged and subjected to the steam fumigation treatment for destroying germs. We bathe, receive back our clothes and return aboard, the operation of fumigating a regiment taking but one day.

When the transport drops anchor off our port, once more we take to the native craft of quartermaster's lighters for landing at the new station. Often two or three of the boats are strung along, one behind the other, and towed. It is quite a sight to look down upon one of these soldier-packed lighters; every soldier is in khaki and the scene is most stirring and war-like. The lighters are hauled up alongside the wharves or once more at the beaches, and the soldiers land as they embarked. Often there may be two or three of the lighters moored along side each other at the place of landing, and then the soldiers in the outer boats must scramble over the inner boats to the wharf. Yet there is little or no confusion; everything is done according to a well-wrought plan;

EMBARKING AND DISEMBARKING OUR TROOPS IN THE PHILIPPINES.

Waiting on the hot sands for the boats. Embarking in a high surf. Afloat. Landing at Marivalles for Quarantine. Barges waiting alongside for the soldiers. Towing ashore. The side tow. Disembarking across several lighters. The barges in tow.

seldom is anything lost and no one is hurt. I have seen several regiments moved this way, from island to island, without the loss of a man, or a piece of baggage, or equipment of any sort.

AN EX-SOLDIER.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE twelfth annual meeting of the Society of Naval Architects and Marine Engineers, which took place in November, at a time following a long depression in shipbuilding, showed, fortunately, no lack of interest on the part of the members. The meeting was well attended and as a social gathering, is becoming more and more an event of importance, as affording a common meeting place for shipbuilders from the east and the west. The society has a strong personal hold on its members. With a membership of about nine hundred, its finances in good condition, there being no liabilities, the outlook under wise management for the society's future usefulness in the profession is decidedly favorable. Regarding the technical sessions, with which, strictly speaking, we have alone to comment upon, this year's meeting may be considered a notable success, as the secretary, through the co-operation of the members, was enabled to publish a set of papers which, taken as a whole, are of very high character. As usual, and natural this year in view of the relative amount of naval and merchant tonnage now under construction, half of the papers presented were on topics pertinent to war ships. One, on the sea-going battleship, gives a most careful and complete analysis of the conditions which effect the design. The importance of each function of the ship is weighed according to its relation to the completed vessel, and deductions are made for a new type of battleship which, however, proves to be much like the latest design in the American and British navies. Data of trial trips and dimensions of government vessels are presented in several papers, and an unusual and concise arrangement of launching data, representing the practice on the two seaboards, are recorded. The other papers deal with a variety of topics of interest to the profession, and an especially valuable treatise on the maintenance of marine machinery deals with a subject, which is, unfortunately, often too little considered by the designer. It is a most careful review of the operating conditions and troubles present in the engine room. The designer should have full knowledge of running conditions at sea, with attending breakdowns, in order to design machinery to give any degree of satisfaction. Also, however carefully the layout of the engine and boiler rooms may have been considered, unless the machinery is properly cared for, serious trouble is bound to result.

That pleasure craft are growing yearly more numerous and popular, and the interest in them becoming more general, is shown by the spirited discussion which arose over several papers presented. The remarkable strides which the autoboat has made during the last year in point of speed seemed impossible two years ago. Just what ultimate position this type of pleasure boat will take is, of course, unsettled, for many consider it but a passing fad; but true it is, that the speed which has been maintained by some of the new boats marks an epoch in speed possibilities.

Unfortunately the transactions of the society have not as yet contained any information relating to the marine steam turbine, which may be attributed to the fact that the first turbine-propelled vessel is yet to be laid down in this country. One of the difficulties met with in turbine machinery is the high rotative speed of shaft and propeller, causing supposedly undesirable cavitation. The design of suitable propellers for such high revolutions has also been a much mooted question, with but little experimental data for guidance. The profession is to be congratulated on having so much information on this latter subject in a paper presented by Naval Constructor

Taylor at this annual meeting. His experiments, with propellers of a variety of pitch as well as different blade areas, cover a range which has hitherto been unexplored. The method of presenting the exhaustive data is so simple that it is within the grasp of any intelligent designer. Abstruse subjects received scant attention at this meeting, and practically all the papers were prepared by men of experience.

THE annual report of Rear Admiral Charles W. Rae, engineer-in-chief of the navy, recently issued, shows a most active condition in the Bureau of Steam Engineering. With repair work conducted at the navy yards on the Atlantic and Pacific annually increasing in volume and character as additions are made to the fleet, the steam engineering plants have necessarily demanded larger buildings equipped with modern tools. The naval station at Cavite has been a busy one during the past year, as nearly three score government vessels and fifteen merchant ships were repaired to a greater or less extent. The year's expenditure at this station amounted to over three hundred thousand dollars—an indication of its importance. During the year, of the larger work in hand, two battleships and four protected cruisers have been placed in commission, and there are now thirteen battleships, eight armored cruisers, and five protected cruisers advanced to different degrees of completion. The report contains the official account of the removal of the two cruisers and two torpedo boats from the shipyards which were closed because of bankruptcy, to the navy yard, and forms interesting reading of these unfortunate events.

The amount of material inspected during the year was nearly half as much again as for the previous year, and reaches the enormous figure of nearly forty thousand tons. The Bureau has prepared plans for one battleship, two armored cruisers, two colliers and last, but most interesting of all, the three scout cruisers. It is the intention to fit one of these with reciprocating engines and the other two with steam turbines. In this latter connection the department has made extensive investigations concerning this new form of propulsion, and at the Annapolis experimental station a suitable laboratory is being equipped for testing steam turbines of the same make as those which are to be used for the scout cruisers. This experimental station is well under way, and the Admiral mentions many lines of research and testing which it is the intention to carry on. Boiler tests, under various air pressures, of two standard types of water-tube boilers used on the battleships, are incorporated in the report; both of these show a very high economic rating. Mention is made of the report of the board of liquid fuel, which has been published separately and contains a very great compilation of trials of liquid fuel apparatus conducted under the direction of the Bureau.

While the report shows a most satisfactory progress of new work in hand, the Admiral sounds a note of warning about the maintenance of the fleet. A modern navy without an efficient engineering personnel is deficient in one of its prime requisites and will fail in the hour of battle. The present condition of engineering in the navy is a cause of great anxiety on account of the few thoroughly trained commissioned engineers. As a result of the personnel bill of 1899, whereby the line and engineering staffs were amalgamated, the engineering force has been so seriously depleted that at present there are not enough officers to assign to the ships and to shore duty. As the requisite training and experience of an engineering officer cannot be obtained except by long service at sea, any steps to remedy this condition will necessarily require several years to bring the service to a point that is desired. The Admiral recommends that a selection be made each year from the midshipmen or ensigns, of a certain number of officers for engineering duty. Owing to the hard physical work and high temperatures which an engineer must necessarily be subjected to, he recommends that no engineer be required to serve at sea after he has reached the age of forty. In compensation for the years spent in one department, whereby the engineer cannot obtain the experience necessary for the command of a ship, he shall thereafter be assigned only to shore duty. Another recommendation is that all officers of the line be given sufficient engineering duty to render them qualified to take charge of this department. This plan is already under trial to a certain extent in the navy. So serious is the result of the lack of officers in the department that the Admiral recommends a reduction of the number of ships in commission. Regarding the warrant machinists who have performed such excellent service, it is recommended that the number be increased, permitting thereby more shore duty; that they receive the same rank as other warrant officers, and that they be graded for promotion.

The Efficiency of the Marine Oil Engine.

Editor Marine Engineering:

Articles have been written the last few months in which the gas plant, composed of gas engine and a gas producer, has been favored over all other kinds of power for marine use. Inasmuch as the producer-gas plant is no further advanced toward perfection than the oil engine, it would seem questionable to predict, too certainly the defeat of the crude oil Otto-cycle engine by the producer-gas plant. The writer has made a study of the oil engine for several years, and feels that a few remarks about the apparent merits of different kinds of power, as compared with the oil engine, in the shape that the oil engine is now, may not be out of place.

The producer-gas plant on shipboard must use a grade of gas having a heat value of about 150 B. T. U. per cubic foot of gas at 60 degrees F. and atmospheric pressure. This is above the average for producer gas. Illuminating gas has an equivalent of 600 B. T. U. in place of the 150 B. T. U. before stated. However, the richer gas is enough more expensive so that it cannot compete with the leaner gas. Owing to the use of the producer-gas the M. E. P. of the marine gas engine cannot be more than 70 pounds. The efficiency of the producer-gas engine is not reduced on account of the comparatively low M. E. P., since the leaner gas allows a pressure of compression of about 170 pounds against a maximum pressure of compression of 90 pounds with gasoline or illuminating gas. The lower M. E. P. will be a disadvantage only in causing the engine to be more bulky as well as heavier per H. P. Recently some reliable figures on the efficiency of different size producer-gas engines have appeared; they are given below. The figures are not all for the same make of engine, but as those turned out by the leading manufacturers differ only in small features and not in general principle, and also since these engines have all the same high-grade workmanship, a comparison of four engines, although of different makes, may be considered a comparison of four engines of the same make.

Make.	Brake H. P.	Thermal Efficiency, per cent.
Westinghouse	50	24.6
Crossley	140	26.85
Crossley	400	29
Premier	500	30.38

These figures are based on the brake horse power and the total energy of the fuel used in the cylinder. For engines of above 500 H. P. per cylinder, it appears that the efficiency would be above 30 per cent. The efficiency of the producer on land does not run above 85 per cent. and it is very probable that this figure will not be exceeded on shipboard. This will make the net efficiency of the producer-gas plant about 25 per cent. The temperature of the air and gas in the producer as it is drawn over the incandescent coals must be more than twice the absolute temperature of the atmosphere. This means that for each brake horse power of the producer-gas engine two cubic feet of gas per minute must be drawn through the hot coals in the process of the formation of the gas. It appears to the writer that it will be necessary to have a bulky apparatus to accommodate such a flow of gas. If it is possible to draw the air through the producer at a high velocity, or perhaps at a pressure above the atmospheric pressure, the bulk and the weight of the producer can be reduced. It would seem, however, that the producer would weigh about as much as the same power steam boiler in spite of any improvements which may be made to the producer.

In order that the producer-gas plant may have a fair show against the oil engine, the weight of the producer and its auxiliaries will be taken here to weigh but 75 pounds for an equivalent of the steam I. H. P. This figure is probably about one-half the actual weight.

In considering the crude oil engine there are several very great advantages which it has over the gas engine. The fuel fed to the former engine is rich, and for that reason the M. E. P. will be higher than the M. E. P. of the producer-gas engine. This increase in the M. E. P. should have an effect to decrease the weight per horse power. Since the fuel is not fed into the cylinder of the engine till it is needed, any pressure of compression can be used in the oil engine from the 500 pounds, which the Diesel uses, to a pressure of 90 pounds or lower if desired. Theoretically the efficiency of the internal combustion engine should increase with the pressure of compression or inversely with the clearance; however, owing to the upper limit to the ignition pressure which is obtained in the internal combustion engine, the efficiency would not increase even theoretically beyond a certain point. The actual efficiency of the engine depends upon the indicated efficiency and the mechanical efficiency. It is probable that the mechanical efficiency begins to fall off after the pressure of compression passes 100 pounds. The maximum efficiency of the internal combustion engine should be at about the point corresponding to a compression pressure of 200 pounds. This has not yet been proved to be the point but will be settled soon, and when settled can be used as the compression pressure for the oil engine, while the gas engine cannot exceed a compression pressure of 90 pounds with rich gas, or 170 pounds with the leaner gas. Owing to the fact that the oil engine can choose its own conditions it is probable that 35 per cent. efficiency is not at all unlikely. For marine work it seems best to have an engine of the four-cycle and single-acting type, although if this is an error on the part of the writer it does not affect the oil engine, as it can take any form which is possible to any internal combustion engine.

For an intelligent comparison between the merits of different plants using coal and oil, each fuel should be taken at prices so that the cost per unit of heat available will remain the same. The reason for this is that vessels are now being fitted to burn oil in place of coal. It is probable that the fuel oil is not much more expensive than coal on a basis of the heat units per pound of fuel.

The steamship *Mariposa,* running between San Francisco and Tahiti, was converted into an oil burner over two years ago, and for the comparisons made here the data were obtained for the most part from the report of the Bureau of Steam Engineering, 1902. The price of fuel was not stated, but coal at $3.00 a long ton seems to be about fair. The calorific value of the coal will be assumed about 14,000 B. T. U.; that of the crude oil about 19,000 B. T. U. Coal would cost 13.4 cents a hundredweight, and oil at the same cost per B. T. U. would cost 13.4 cents for 73 pounds. On this basis steam power would cost the same, as far as the fuel was con-

cerned, regardless of whether oil or coal was used. Oil at 13.4 cents for 73 pounds is about equivalent to 1.41 cents per gallon.

The *Mariposa* is 314 feet long, 41 feet beam, and 22 feet mean draft. The vessel was, at the time of being remodeled, fitted with tanks to carry 905.43 long tons of oil, sufficient to last the round trip from San Francisco to Tahiti and return, a distance of 7,098 nautical miles. The I. H. P. of the vessel is 2,500, and therefore the B. H. P. must be about 2,100. The power of the auxiliaries was not given. The second trip of the *Mariposa* was more economical than the first, owing to the experience gained on the first trip, and perhaps also on account of the fact that it was made at a slightly slower speed. On this second trip 734.14 tons of oil were consumed. On a basis equal to $3.00 a ton for coal, this oil would be worth $4.09 a ton, or the total fuel consumed on the trip would be worth about $3,000. The average efficiency on the trip may be assumed to have been about 9 per cent., based on the B. H. P. of the main engines. As the power of the auxiliaries is not known, it will be necessary to credit the main engines with the assumed power consumed by them; 995 tons of coal, at the above mentioned calorific value, would have been required to get the same results as were obtained with the 734 tons of oil. Using a gas producer and gas engine for the power we shall have to reduce the efficiency of 25 per cent. to 20 per cent. to allow for the extra power in the auxiliaries. The producer would use 448 tons of coal at $3.00 a ton, or a total of $1,344 for fuel for the producer-gas plant. Using oil engines for power, the efficiency of 30 per cent. would have to be reduced to 24 per cent. to allow for the auxiliaries. The equivalent of 2,500 steam I. H. P. would require 267 tons of oil at a value of $4.09 a ton, or a total value, for the oil engine plant for the trip, of $1,093.

In the following table the weights are obtained for total machinery, by assuming that for both steam plants 300 pounds per I. H. P., for the producer-gas plant 280 pounds, and for the oil engine 205 pounds.

Supposing that the *Mariposa* be equipped with any one of the four different types of power mentioned before, with fuel to make the trip to Tahiti and back the different weights will be as below:

	Machinery.	Fuel.	Total.	Cost of Fuel.	Saving.
Coal burning steam..	335 tons.	995 tons.	1330 tons.	$3 000	....
Oil burning steam....	335 "	734 "	1069 "	3,000	...
Producer-gas (coal)..	313 "	448 "	761 "	1.344	$1,656
Oil engine plant.....	229 "	267 "	496 "	1,093	1,907

In any engine plant the wages are an appreciable part of the expense of operation of the plant. The following is the actual engine-room force of the *Mariposa* when coal was burned, and also when oil was the fuel; also an estimate of the crew necessary for using a producer-gas plant and an oil-engine plant, with what seems a fair schedule of wages under the four conditions:

	Coal Steam.	Oil Steam.	Producer-gas.	Oil Engine.
Chief engineer.....	1 @ $150—$150	1 @ $150—$150	1 @ $150—$150	1 @ $150—$150
Assistant engineer....	3 @ 100— 300	3 @ 100— 300	3 @ 100— 300	3 @ 100 - 300
Oilers.....	3 @ 60— 180	3 @ 60— 180	3 @ 60— 180	3 @ 70— 210
Firemen.....	12 @ 45— 540	3 @ 45— 135	6 @ 45 - 270	
Coal passers.....	12 @ 40 - 480	....	6 @ 40 - 240	....
Water tenders.....	3 @ 60 - 180	3 @ 60 - 180	....	....
Messenger.....	1 @ 30— 30	1 @ 30— 30	1 @ 30 - 30	1 @ 30— 30
Storekeeper.....	1 @ 60— 60	1 @ 60 - 60	1 @ 60 - 60	1 @ 60— 60
Totals.....	36 $1,920	15 $1,035	21 $1 230	9 $750

It happens in this case that the wages per month go directly with the cost of fuel per trip since the *Mariposa* makes one trip per month. As before stated, no data were available upon the subject of salaries, but figures given are no doubt near enough to actual wages, including cost of feeding the men.

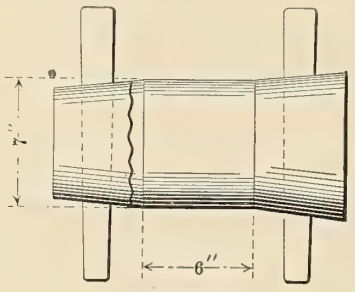
It is probable that the first cost of the oil engine plant will ultimately be considerable less than the cost for the same power steam plant. The oil engine plant will weigh less than the steam plant and there is no reason to expect that the cost per ton of machinery will be greater than for the steam engine.

The total cost per month for operating the *Mariposa* with the four kinds of power, accounting for the fuel used and the wages paid, may be estimated at $4,920 for the first case, $4,035 for the second, $2,575 for the third and $1,833 for the oil engine plant. The saving in dead weight over the steam engine using coal is 261 tons for the second case, 568 for the third and 833 for the oil engine plant. This saving in dead load, which could be utilized for carrying more cargo, should be worth about $3.00 a ton at the very least for the round trip of 7,000 miles. The saving in dead weight, if used up with cargo at this figure, would pay all the expenses of operating the oil engine plant and leave a surplus of $656. The cost of operation of the oil engine plant (with all space taken which was available for cargo) would be $5,576 less than the cost for the steam plant with coal, $3,908 less than the steam engine using oil and $1,530 less than the producer-gas plant.

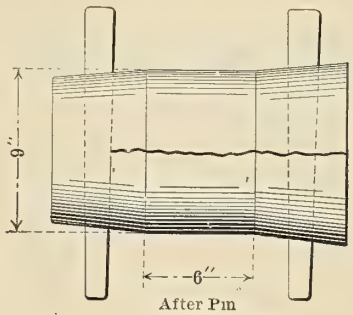
There is no question but what the writer has taken the figure for the price of oil too low, but supposing that the price of the oil is doubled, the increase in the price of fuel for the oil engine will not much more than eat up the surplus of $656 left from the extra cargo carried after taking out the cost of help and fuel. A barrel of oil contains 42 gallons. At twice 1.41 cents a gallon the barrel of oil will be about $1.20.

To the writer it seems that the stir which is now being made in favor of the turbine of one kind or another will be comparatively short lived. For large powers there are great obstacles to be overcome before the steam turbine will be a success. The large power in a vessel naturally calls for a large propeller with a low number of revolutions. The turbine on the other

hand, to be of its least weight per horse power, must be comparatively small diameter and have a high number of revolutions. The two conditions may be partially met, but the result will not show either the propeller or the turbine to its best advantage. There does not seem to be any objection to the design of an engine plant for ocean liners having a power equal to 60,000 steam I. H. P. and using the crude oil Otto for the power. This could probably be done with twin screws, eight cylinders on a shaft, each cylinder generating about 4,000 H. P. This power could be put into a liner about 600 feet long and better time made than is possible with any practical sized steam vessel. Knowing what is being done in the line of developing the crude oil Otto and what the promise is for the future, it seems very evident to the writer that any future important stride in marine engineering must be made, not with the producer-gas plant or the turbine, but with the crude oil engine. JOHN F. WENTWORTH.



Forward Pin



After Pin

Marine Engineering

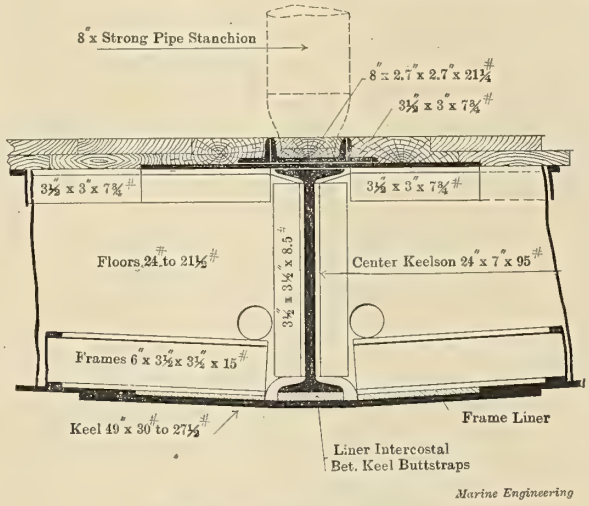
Broken Crank Pin.

The steamer *N*——, a combined freight and passenger steamer of 1,188 gross tons, plying across Lake Michigan, in the month of January, 1904, was sent to the Ferryburg Iron Works for repairs to engines and boilers. She had been in continuous service for eleven months, which included some very heavy work in the ice fields encountered on the route. On taking the crank pin brasses down for examination and adjustment, a very peculiar condition was discovered, both crank pins being broken entirely through, as shown by the drawings.

Her engines are twin steeple compound, cylinders being 20 and 40 inches diameter and 36 inches stroke, steam pressure 92 pounds, revolutions per minute 88. The engines had run no one knew how long in this condition, and gave no indication of the pins being broken, except a slight knock in the forward engine on the bottom center. The forward pin is 6 inches long by 7 inches in diameter; after pin 6 inches long by 9 inches diameter, both keyed into cranks with a double taper. The broken end of the forward pin had to be drilled out as it was impossible to remove it in any other manner. New pins were fitted in and the steamer went in commission in a few weeks and is now covering her route as usual. JAMES D. STEWART.

Novel Center Vertical Keel.

The arrangement of center vertical keel shown in the accompanying engraving has recently been incorporated in the construction of some vessels building in this country, and has much to recommend it on the score of economy and simplicity of construction. The method illustrated was devised by Mr. G. Simpson, recently superintending constructor at the Townsend-Downey yards, and the method by which the scantlings of the various members were calculated was as follows: The scantlings were first taken out in accordance with the requirements of one of the classification societies for a given numeral for the orthodox vertical keel and center keelson construction and the moment of inertia of these calculated about the neutral axis of the ship, as it is the author's contention that such parts of the ship's structure as keelsons, etc., should not be considered as individual members, as is too often done, but as parts of the vessel viewed as one large girder. With this as a basis the novel arrangement shown was figured to give an *equivalent* moment of inertia about the ship's center of gravity. It will readily be seen that it was possible to do this and still save weight owing to the greater section of the I-bar used and its increased distance from the neutral axis. The saving in weight we understand is quite considerable for an equal strength, and of course it will be seen that there is only about one-third of the fitting and riveting entailed in this method of construction. It will also be noticed that great stowage facility is obtainable owing to the complete elimination of the usual obstructive center vertical keelson. The construction shown has been approved by the principal classification bureaus.

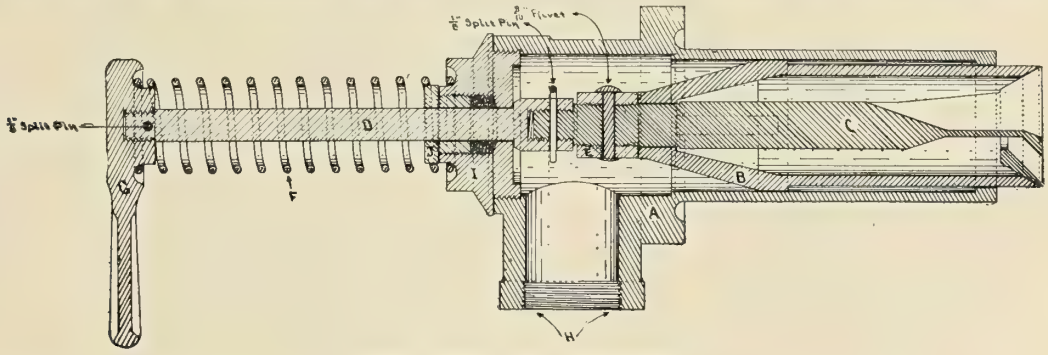

8" x Strong Pipe Stanchion
8" = 2.7" x 2.7" x 21¼#
3½" x 3" x 7¾#
3½" x 3" x 7¾#
3½" x 3" x 7¾#
Floors 24# to 21½#
3½" x 3¼" x 8.5#
Center Keelson 24" x 7" x 95#
Frames 6" x 3½" x 3¼" x 15#
Keel 49" x 30# to 27½#
Frame Liner
Liner Intercostal
Bet. Keel Buttstraps
Marine Engineering

NEW FORM OF CENTER KEELSON.

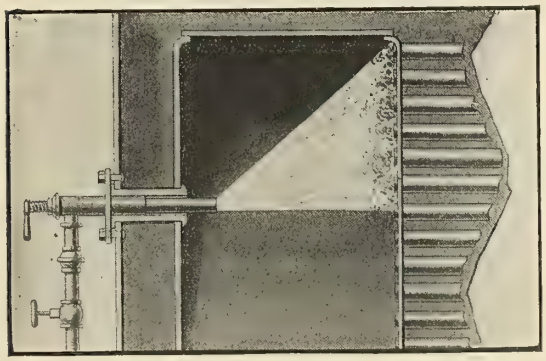
ENGINEERING SPECIALTIES.

New Steam Flue Blower.

The operation of blowing out soot from the tubes of a fire-tube boiler has always been a very tedious one, and at the same time has necessitated a partial shutting down of the boiler. The usual method has been to attach a small blower with hose to a steam pipe and insert the blower in the front ends of the tube. To do this of course the smoke boxes must be opened, checking the draft. The soot has to be blown against the natural draft of the boiler. The result is that the soot is blown back into the boiler, the draft is checked, and the steam pressure will drop. Allowing about a quarter of a minute for blowing each tube, the operation by the old method would take almost an hour, and then, as is well known, the tubes are not perfectly clean at the back. The Diamond steam flue blower, Hodge patent,



SECTION OF NEW STEAM FLUE BLOWER.



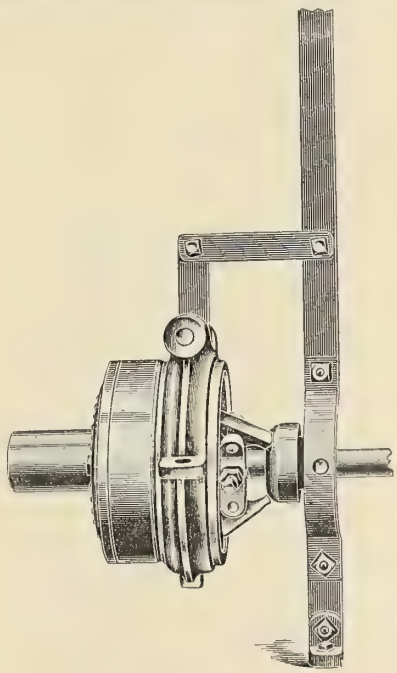
CLEANING BOILER TUBES WITH NEW STEAM BLOWER.

made by the Power Specialty Company, 513 Washington arcade, Detroit, Mich., is a simple device entirely free from the disadvantages of the old method. It is installed in the rear end of the boiler and blows the soot with the natural draft of the boiler to the front and up the funnel. It is stated by those who have used it that to thoroughly clean all the tubes does not take more than five minutes, because it cleans in each operation a cluster of tubes.

Referring to the sectional view: the shell, *A*, is inserted through a tube in the back head of the boiler, into the combustion chamber. Steam is admitted to the nozzle tube, *B*, and nozzle, *C*, through the connection, *H*, and the pressure drives out the nozzle and tube against the compression of spring, *F*. The nozzle is of such a form that the spray of steam is directed at an angle to the axis of the cleaner, and by turning the handle, *G*, the nozzle will revolve causing the steam to spray through a multitude of tubes, within a diameter of 4 feet 6 inches at one time. The flow of steam removes the soot from the tubes and carries it up the funnel.

Ball Reverse Gear.

The Ball improved reverse gear manufactured by the New York Gear Works, 56-58 Greenpoint avenue, Brooklyn, N. Y., is designed to overcome the difficulties of the ordinary reverse gear. There are two disks, one at the front and one at the back of gear, which are



A NEW REVERSING GEAR.

locked together for forward motion by throwing the hand lever forward. When the lever is vertical the disks unlock and the gears run free, therefore the propeller shaft does not revolve. When the lever is thrown aft the gears are brought in mesh and the reverse motion is secured. Spur gears are used made of steel with hardened teeth and run in oil. The device is strong and compact and will stand hard service. It is being used extensively by some of the best marine engine builders.

The Triumph Rod Packing.

The increasing use of high-pressure steam, superheaters, and gas and oil engines has produced a demand for a rod packing capable of continued satisfactory service under high temperatures. James L. Robertson & Sons, of 204 Fulton street, New York, N. Y., feeling the growing urgence of this demand, have for some time been seeking such a packing, and it was in Germany, where both the internal combustion engine and the superheater have reached their highest development and widest application, that their quest has been successful. The packing which they are offering under the above trade name, is one which is being used in large quantities by the Krupps, Borsig, and many other prominent continental builders, and in the German, Austrian, French, Italian, Russian, and Danish navies. It is made up of a series of half rings, of which one is shown in Fig. 1, which are placed in the stuffing box, as shown in Fig. 2, so as to break joints, and with a section of fibrous packing between the gland and the outer section. These half circles are filled with an indestructible lubricant and closed at each end with a metallic diaphragm, so thin as not to resist materially the change of shape of the tube under pressure. The tube is made of an anti-friction alloy, which is varied according to the temperature at which the packing is to be used. Under the pressure of the gland the packing takes an approximately rectangular section, completely filling the stuffing box, and the rod is thus surrounded by a surface of anti-friction metal with automatically formed retaining grooves between the rings, and lubricated with the material which exudes through the perforations in that surface. The packing being made in sizes to fit the rod and box, is as simple of application as the ordinary fibrous packing, and absolutely no change is required in the box or gland. Some 68,000 stuffing boxes are packed with it in Europe. It is claimed to be particularly applicable to compressors, both air and ammonia, in expansion or slip pipe joints, and for acids.

FIG. 1, A SECTION OF THE TRIUMPH ROD PACKING.

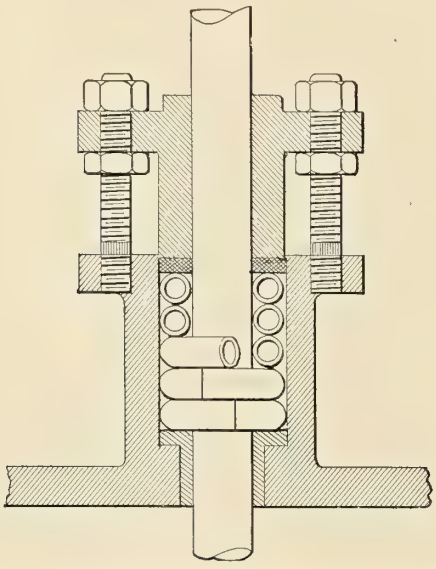


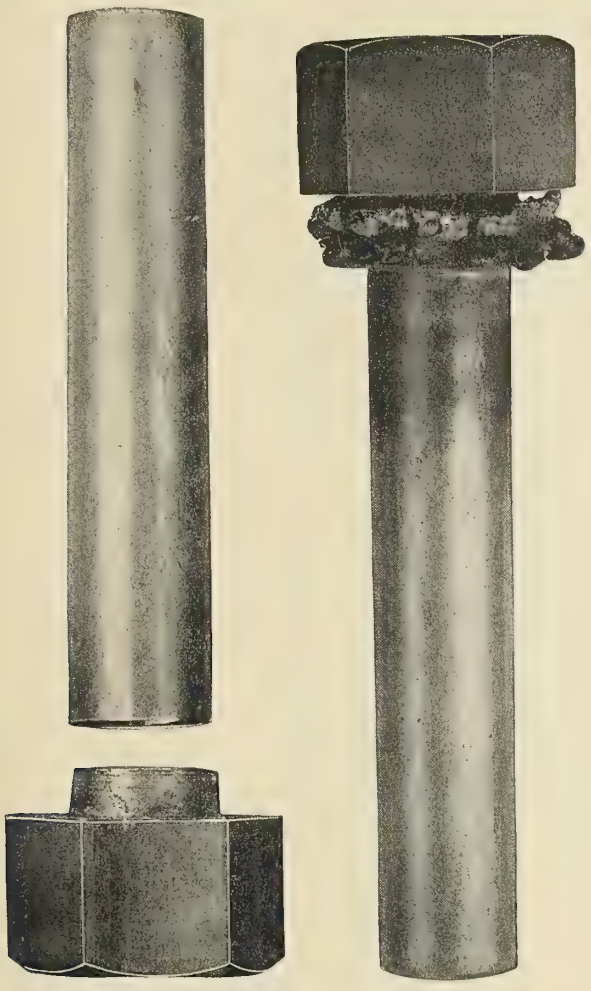
FIG. 2, SHOWING METHOD OF APPLYING NEW ROD PACKING.

Uniform Finished Machine Bolts.

A new process of making screws and bolts has been brought out by the Cleveland Cap Screw Company, 66 Clarkwood avenue, Cleveland, Ohio, which is not only most interesting but permits of an absolutely uniform and exceedingly strong bolt. The heads are made from special die drawn stock—hexagon, square, or round—according to the style of head required. These are cut from a bar on automatic machines which turn a projection or shoulder, to the diameter of the screw to be welded as shown in the cut. The stems are also cut from the same quality round stock which is the diameter of the screw. Thus the threads of the screw are cut directly on the surface of the die drawn stock, which has been proved to be much stronger than the inner portion, as this part of the material is denser and more compact, owing to the pressure of the dies in drawing. This method not only accounts for the greater strength of the screw, but reduces the cost very greatly by re-

ducing the amount of metal required from that of the ordinary screw.

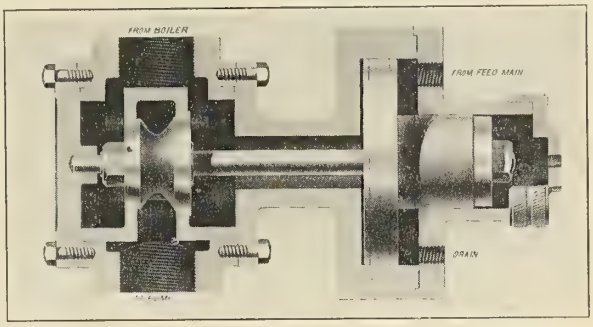
The heads and stems are placed in the welding machine and held firmly by copper vises, which are clamped to gun-metal platens. These platens are moved on steel ways by hydraulic pressure. The sections to be welded are brought together, completing the circuit, and the current is then allowed to pass through these sections until they are brought up to a welding heat, at which time a greater pressure is applied, forcing the two together, expelling any possible slag or deteriorated metal, and forcing up a burr, as shown in the cut.



HEAD AND SCREW BEFORE AND AFTER WELDING.

The next process is the milling down of the burr, which is done by machinery especially constructed for this purpose. At the same time the top of the head is shaved and chamfered, and the under part of the head is faced and the end pointed. It will be seen that this process results in absolute uniformity in the length of the screw, thickness of head, and the alignment of head and body. The blank is then ready for threading, for which special machinery with lead screws are employed for feeding the screws into the dies, which method insures accurate and well-formed threads.

The electric welding process is not confined to making a steel head and steel stem; the company turns out a bolt specially adapted for salt water service where the head is made of tobin bronze or brass and the screw of steel. This meets government requirements where non-corrosive metals are called for. In recent tests carried on, comparing the Cleveland cap screw with twelve other makes, the average tensile stress found was 73 per cent. greater for the Cleveland screw. The bolt is already largely used by engineers who desire a uniform product.



VALVE FOR AUTOMATIC CONTROL OF BOILER FEED PUMP.

Automatic Boiler Feed Pump Controller.

A simple, and, it is claimed, very effective, governor for the boiler feed pump and controlled by the relative pressure of steam and water is herewith illustrated. It is attached directly in the steam line to the pump, and does away with the customary relief valve. With this device, when steam pressure falls, the controller, by reducing the supply of steam to the pump, will shut the pump down, and, conversely, when the steam pressure in the boiler rises, the controller allows additional steam to be delivered to the pump. Thus the action of the controller regulates regardless of the fluctuations of the steam pressure in the boiler and also tends to steady said pressure.

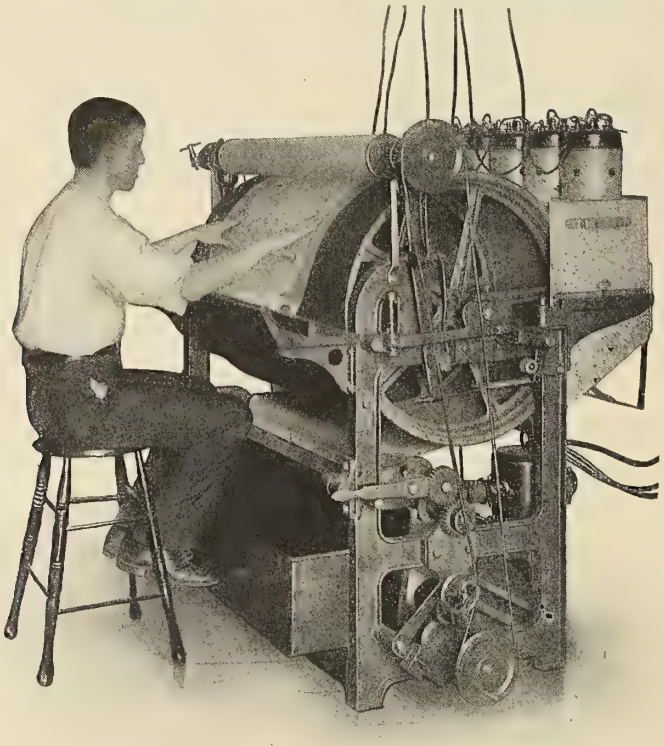
In the sectional view here given the method of balancing the floating piston is illustrated. The steam valve at the left is of the piston type, as steam entering at the top entirely surrounds the valve and valve stem, and the steam pressure is also exerted against the front of right-hand piston. Behind this piston is the water pressure at the water end of the pump. The joints are ground, and metallic packing is used on the water end which may be readily taken up for wear. The steam valve and bushing are of bronze. This valve is made by the Federal Valve Company, 2534 Western avenue, Seattle, Wash.

Blue Printing Machine.

The method of making blue prints by means of a glass cylinder and arc light has quite superseded the original flat plate machine.

The apparatus brought out by the Specialty Print Paper Company, Incorporated, 44 Federal street, Boston, Mass., and termed the Federal blue printing machine, records another conspicuous step in advance for speed and quality of work. The present device illustrated on

this page is of a continuous feeding mechanism. The disadvantages of the glass cylinder, such as the liability of breaking the expensive glass, the loss of time in preparing the apparatus for each separate copy, the limited sizes of prints to be taken at one time, and the labor required in handling the heavy plate glass are entirely absent in the Federal machine. The latter consists of a large drum mounted on roller bearings. Directly above is a small roll upon which is wound a long strip of flexible transparent material called the apron. The ordinary high-grade tracing cloth is generally used for this purpose. This apron lies close upon the drum for about half the circumference, and thence to a winding roll at the bottom. The space between the apron



NEW BLUE PRINTING MACHINE FOR CONTINUOUS OPERATION.

and the top surface of the drum is where the blue print paper and tracings are fed to the machine. The surface of the drum covered by the apron forms the exposing surface of the machine. A reflector supporting a series of lamps is arranged to confine and reflect the rays of electric lights upon this exposing surface. After the tracings and blue prints have been exposed they drop into a box at the bottom. It will thus be seen that as the drum revolves it carries apron, tracing, and blue print paper with it. A perfect contact between tracing and blue print paper is secured by keeping the apron tight. The machine is made in three sizes, with drums 30, 42, and 54 inches in length. The advantages of this machine are that tracings of any length may be printed; that the machine works continuously; and that the amount of exposure, and therefore the printing, can be regulated to a nicety by the operator by increasing or decreasing the speed of the operating motor.

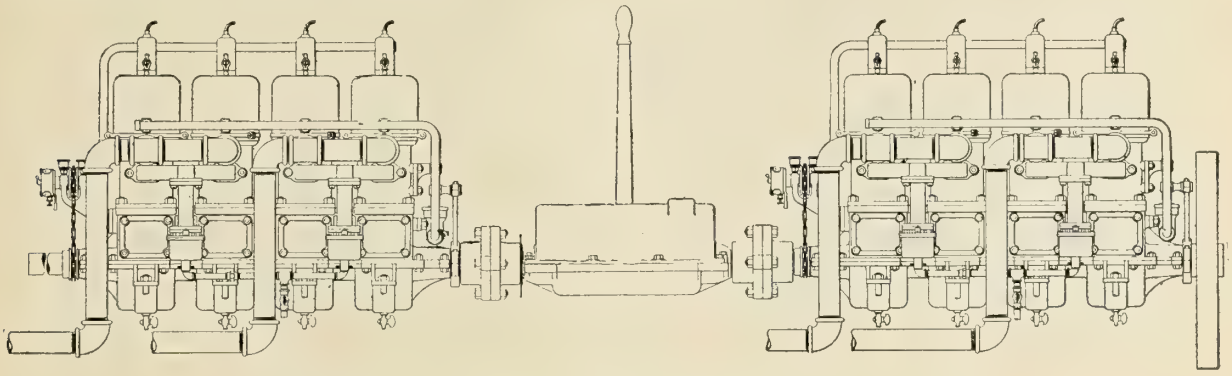
A New Two-Cycle Engine.

The accompanying cut shows a light-weight, high-speed engine, designed for E. H. Godshalk & Co., of Philadelphia, Pa., by E. W. Roberts, Clyde, Ohio.

This engine is of the two-cycle type, 4 1-2 inches bore by 5 inches stroke, and, as is usual with such an engine, is made in two four-cylinder units. What is perhaps an innovation in an eight-cylinder engine is the placing of the reversing gear between two engines, in order to save weight and avoid the necessity of an extra clutch betwen the two engines. As the two-cycle engine will run in either direction by simply changing the lead of the spark the forward engine may be run in one direction and the after engine in the other; or the forward engine may be used to start the after engine in the reverse direction and the forward engine then cut out. By disconnecting the two engines the forward engine may be started by hand and then used to start the after engine by operating the clutch, thus avoiding the use of a starting device.

The principal features of this engine are that the crank cases are of nickel aluminum so treated as to be unaffected by the action of salt water, and the cylinders are of cast steel. The designer claims to have found by experiment in his own laboratory a cast steel that will stand the service. The water jackets are separate from the cylinders and are made of seamless drawn steel shells. The vaporizer is of the compensating type, needing no adjustment for changes in temperature, or in the speed of the engine. The engine has absolutely no valves, as it is of the three-port type, the inlet to the crank cases being opened and closed by the piston. This

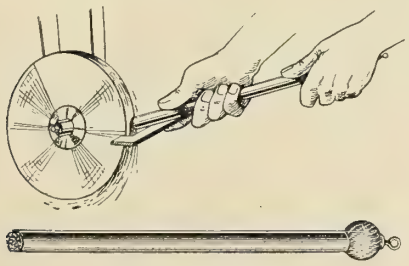
form is found better adapted to high speeds than a check valve. Ignition is of the jump spark type, the timer being driven by a silent chain and the timer shaft supported on a bracket at about one-half the height of the engine. The spark plugs are entirely enclosed in a moisture-proof shield. The engine is 21 inches high from the center of the shaft to the top of the spark-plug shield, and the forward engine is 42 inches long from the center of the coupling to the outside of the fly wheel. The approximate weight of the two engines, exclusive of the reverse gear, is 600 pounds, and at 950 r. p. m., which is the normal speed of the engine, it will develop between 60 and 65 brake horse power.



TWO-CYCLE, 60-HORSE POWER, 8-CYLINDER, HIGH-SPEED MARINE GASOLINE ENGINE.

E. H. Godshalk & Company, manufacturers of Giant engines, propose to build quite a number of different sizes on this same general design. The smallest of these will be 3 7-8 inches bore by 4 inches stroke, developing 4 1-2 horse power per cylinder. A second size will be 4 1-2 by 5 inches, developing 7 1-2 horse power per cylinder. The largest size will be 5 1-8 by 6 inches, developing 11 horse power per cylinder. The normal speed on which these three sizes are rated is 950, 900, and 850 respectively.

No pains have been spared to make this design first class in every particular, with ample strength in all parts and large wearing surfaces, keeping the weight down to the lowest practical limit for good service, making the engine not only of great value as a racing machine, but also for boats where small space and continuous duty are factors.



EMERY WHEEL DRESSER.

The Semi-Diamond Tool.

An emery wheel dresser manufactured by the International Specialty Company, 35 Holden avenue, Detroit, Mich., is designed to take the place of the expensive black diamond. This is the most efficient tool for the purpose, and the makers state that it will do the work of truing and shaping emery wheels in as satisfactory a manner as the diamond dresser. The Semi-Diamond dresser is a steel tube filled with the hardest abrasive that can be obtained, which presents new cutting edges the entire length of the tube and as long as it lasts, which is from three to five years with ordinary use. The dresser is not recommended for water grinders or very hard wheels, although it can be used on such if necessary. Its efficiency is best demonstrated on grades up to medium hard.

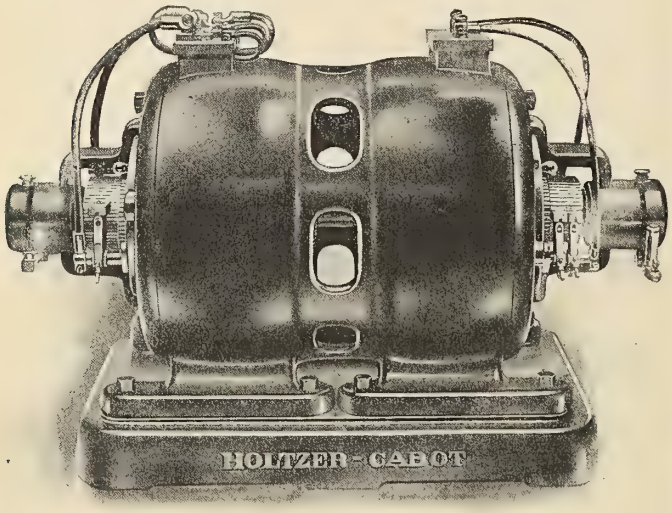
Motor Generators.

With the increase in use of the storage batteries for launches, automobiles, and private lighting plants, has come the demand for a compact and efficient form of charging motor generator. The advantages of the motor generator over the dynamotor for work of this class are well known. In the first place the primary and secondary circuits of the motor generator may be much more effectively insulated from each other than can the windings of the dyanmotor. Furthermore, the secondary voltage of the dynamotor form of machine cannot be regulated except by means of a line rheostat in the secondary circuit or by a speed controller in the motor circuit using resistance in series with the armature, both these methods requiring expensive rheostats and producing a very uneconomical conversion.

The motor generator form of machine is more flexible in its adaptation to the engineering conditions. The voltage of the secondary may be regulated by the field rheostat and if the fields of the generator are separately excited from the motor circuit the voltage of the generator may vary from zero to the full potential of the machine, the current output and stability of voltage being retained throughout the entire range. The machines here illustrated have two bearings, the two intermediate bearings being eliminated. The motor and generator cores are mounted on a common shaft which is continuous. The speeds are low and the shafts quite heavy, so there is no vibration or tendency of the shaft to spring. The output of the machines range from 1-4 to 4 1-4 Kw. The machines may be wound for any direct current circuit, and the secondary wound to give any voltage from 20 to 500.

The manufacturer is also prepared to supply machines of the same range and outputs to the two-bearing construction but of the open type. There is no particular preference in favor of either type, although possibly the open type is a little more accessible.

While these sets are intended primarily for charging batteries they have been found useful in other lines of work, particularly in telegraphic work for operating main and local circuits. The Western Union Telegraph Company is using large numbers of the semi-inclosed type, while the Postal Telegraph Company has in operation quite a number of the open type.



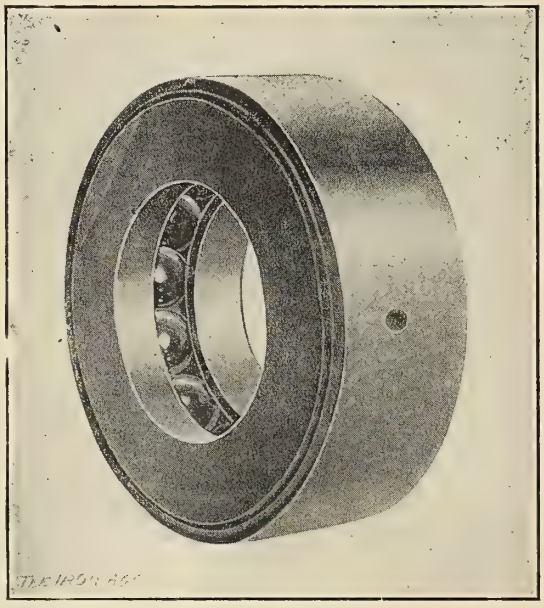
NEW COMPACT TYPE OF MOTOR GENERATOR.

The motor generators are being manufactured by the Holtzer-Cabot Electric Company, Boston, Mass.

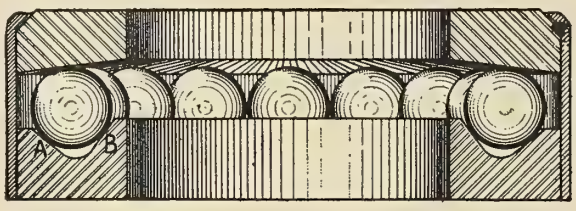
Standard Ball Bearings.

The success or failure of ball thrust bearing depends practically upon the balls which are used therein, and while there are several different manufacturers of ball thrust bearings, the American Ball Company, Providence, R. I., has the unique distinction of being the only manufacturer of ball bearings which manufactures also the balls. These are made by a special treatment from a special high grade of tool steel, into an extremely tough and uniformly hard ball, with great wearing qualities and of high crushing strength. These bearings are manufactured under the patents of M. Reid, in several different forms to suit requirements. A typical bearing is that illustrated in the sectional and perspective views herewith given. The plates are made of tool steel hardened clear through by a special process, and both plates are then ground true to exact dimensions. The sleeve is made of light carbon steel, not hardened, and is driven over the lower breast plating with the upper plating a free running fit and held in place by the flange.

The aim in this design was to construct a bearing in which there should be only rolling contact between the balls and the ball raceways. The two points of contact on the lower plate are in such a position in relation to the axis of the shaft, that the rolling contact circles on the balls are both the same proportion to the contact circles on the same plate. The point of contact on the upper thrust plate is in a plane parallel to a line drawn through the two points of contact on the lower plate; thus it will be seen no sliding can take place between the balls and raceways, and the load on the two points of contact must be equal. The tendency to force the balls outward on account of the difference in the angles of contact on the lower plate is counteracted by the angle on the face of the upper plate forcing them in the opposite direction.



BALL THRUST BEARING.



SECTION OF BALL THRUST BEARING.

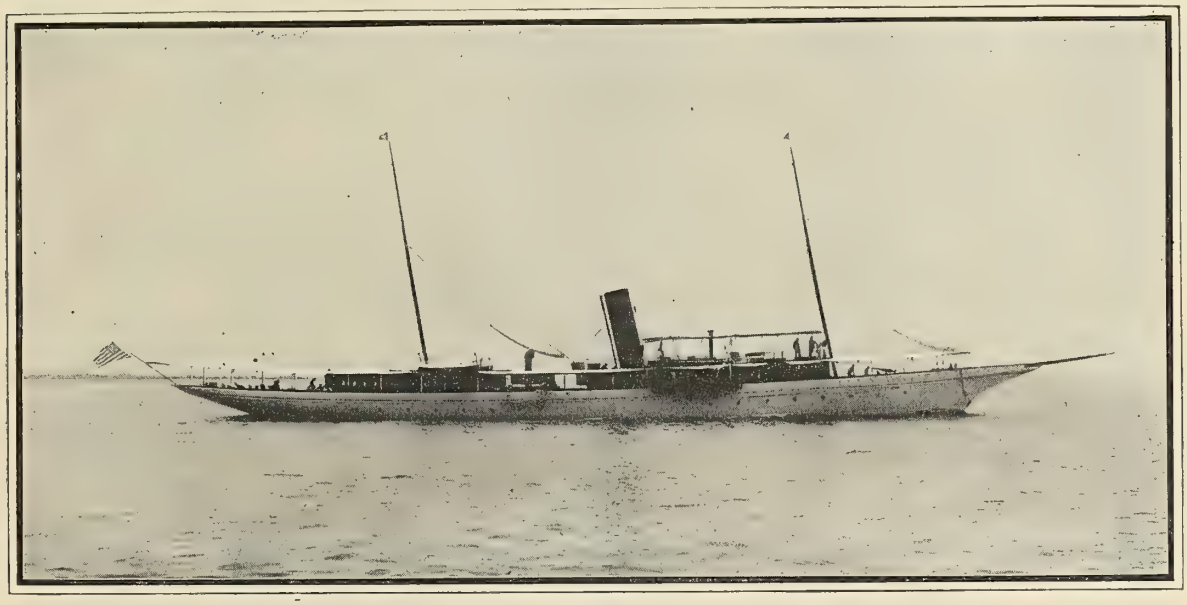
If space permitted mention would also be made of the other styles, and especially No. 1A, which is designed for light work. In regard to the design, selection of material of bearing and of ball, and the finish, the aim of the manufacturer has been to turn out bearings that will reduce to the lowest minimum the amount of friction in a thrust bearing.

Acetylene Safety Storage System.

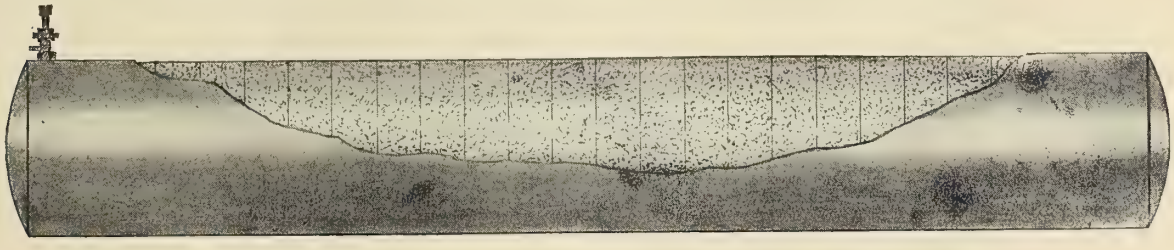
A very satisfactory system for lighting yachts and small boats with acetylene gas is handled by the Commercial Acetylene Company, 80 Broadway, New York, N. Y. Recent developments in storing acetylene gas, consisting chiefly of filling the cylinders with asbestos,

fire brick, or other absorbent material, practically prevent all possibility of an explosion under any circumstances. The system is especially desirable for use on sailing craft, or steam vessels where it is not desirable to run the dynamo throughout the night, or to install an expensive storage battery. The system here described is largely used in Europe, and already many installations have been fitted on land and water in this country.

In the first place, the quality of the light is more nearly like sunlight than any other artificial illuminant. At the same time the quantity used in a gas jet is only 1-10 that of an ordinary burner used with the best city gas, and with 50 per cent. more candle power. The smaller quantity means that the piping may be reduced and also that the danger from asphyxiation or explosion is proportionately reduced. The flame from an acetylene burner is a small, compact one which cannot be blown out, as was clearly demonstrated at the Buffalo exposition and elsewhere, and is thus especially desirable for use on board ship. In this storage system gas called acetone is used in combination with the acetylene, by which it is claimed that the carrying capacity of any tank of a given size under a given pressure is greatly increased. It is estimated that a yacht such as the *Oneida,* which is fitted with twenty-seven acetylene burners, requires but 450 cubic feet per month; the tanks installed are 16 inches diameter and 54 inches long and hold 900 cubic feet of the gas. This one tank will last two months. Several other yachts, including the *Haouli,* here illustrated, make use of this system of lighting, which, it is claimed, gives perfect satisfaction.



STEAM YACHT HAUOLI, LIGHTED BY ACETYLENE GAS ON THE SAFETY STORAGE SYSTEM.



SECTION OF SAFETY STORAGE TANK FOR ACETYLENE.

Marine-Engine Governor.

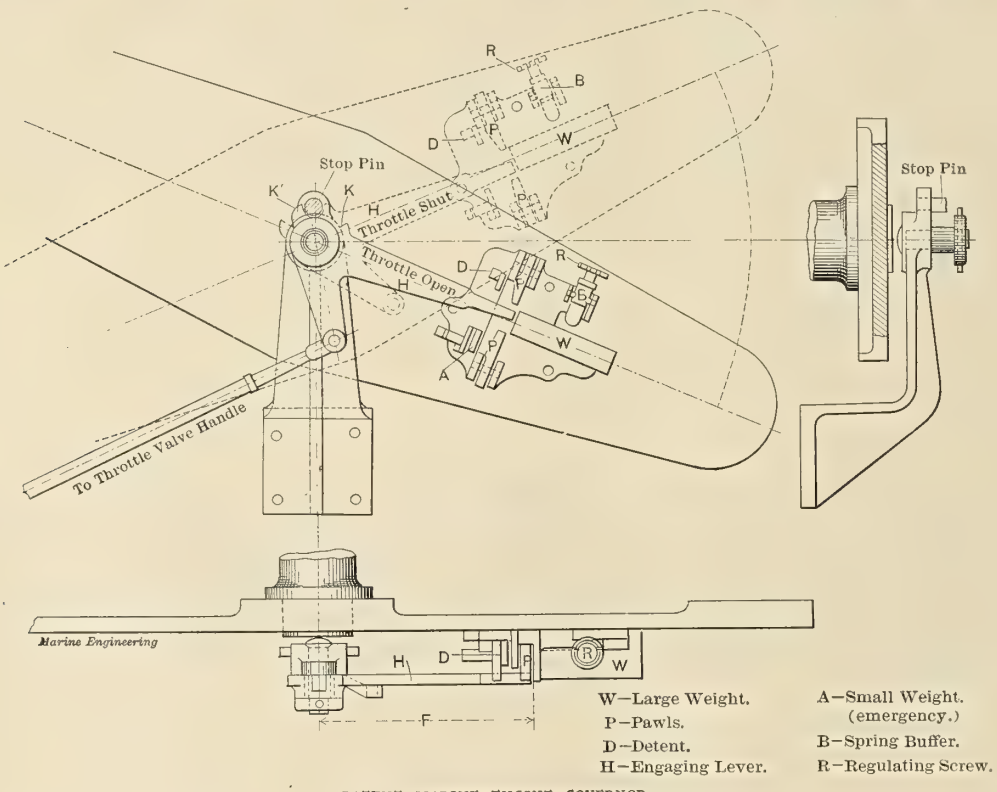
The Aspinall marine-engine governor is a simple and inexpensive device attached to marine engines which not only will prevent racing in heavy weather but will shut off the steam entirely in case of a breakdown. It works automatically, controlling the revolutions of the engine within 5 per cent. of any predetermined speed, thus preventing the sudden excessive strains which so often cause fracture of shafting or more serious accidents. The governor, which weighs from 17 to 50 pounds, is fixed on the pump levers, or other reciprocating part, and being exceedingly sensitive, certain, and powerful in its action, the slightest acceleration of speed shuts off the supply of steam by means of the throttle or other valve. The governor consists of a hinged weight, *W,* operating two pawls, *P, P,* carried on a frame which is bolted to air-pump lever, or other reciprocating part.

When the revolutions of engines are increased by about 5 per cent. above the normal speed, the weight, *W,* is left behind, and reverses the position of the pawls, causing the bottom one to engage with the lever, *H,*

lifting it throughout the whole upward stroke, and thus shutting off steam by closing the throttle valve. On the return stroke the detent, *D*, is lifted, liberating the weight, *W*, and, if the revolutions have moderated, the position of the two pawls is again altered, the top pawl now engaging with lever, *H*, depressing it, and thus re-opening the throttle valve.

The emergency gear only comes into operation in case of a very excessive race, such as losing a propeller or a broken shaft, in which case the small weight, *A*, is left behind and locks the weight, *W*, in the "shut-off" position, thus effectually preventing the re-opening of throttle valve. To unlock the emergency gear, press the large weight, *W*, upwards from the under side, when the small weight, *A*, will fall out of gear.

The governor has been successfully fitted to over a thousand modern steamers, including all of the well-known transatlantic fleet. It is manufactured by the Aspinall's Patent Governor Company, 7 Strand street, Liverpool, Eng.



PATENT MARINE ENGINE GOVERNOR.

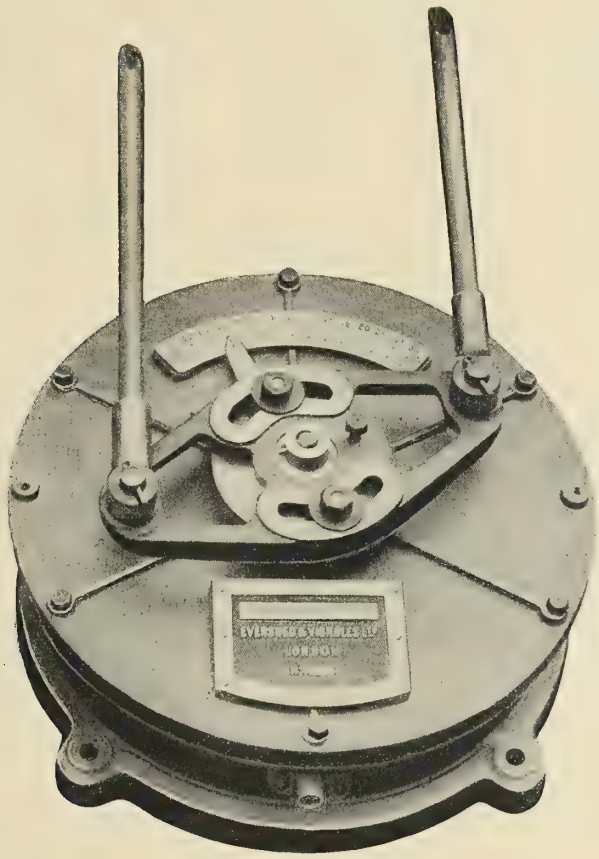
Transmission of Intelligence on Shipboard.

For some years the Evershed-Vignoles Company of London has been occupied in the development of a most interesting line of special telegraph apparatus for the transmission of information on shipboard. Certain types of this apparatus are intended to indicate the position of the helm and others to transmit from a distance orders to the engine room. The system consists essentially of an indicator involving the principle of the measurement of electrical resistance. In this indicator the position of the index is determined by the relation of the currents in two coils placed at right angles to each other. The transmitter consists essentially of a series of resistances with contacts on which one can move a handle or governing arm. If one of these coils is connected to one of the extremities of this series of resistances and the other coil to the other extremity, if, furthermore, the current enters through the handle and leaves at the joint where the coils are connected to each other, the position of the index of the instrument will depend on the position of the handle.

In the helm indicator the transmitter contains the resistances and a handle. This last is put into operation by two parallel bars which connect it with the helm. The position of the coupler determines automatically, in the manner already indicated, the position of the needle of the indicator. Several indicators may be connected in circuit with one transmitter. The officer of the watch can then readily keep himself acquainted with the position of the helm, whether on the bridge, or poop, or other part of the ship. There is never need for more than three lines of wire connection, usually made in cable form with three parts in different colors. All parts of the apparatus are water tight.

The second application has for its purpose the control of the ship, either from the poop, or any other point at pleasure, without calling into operation either mechanical agencies of any kind, or water pipes, as in the case in which one might wish to employ a telemotor. The direction telegraph provides for the control of the ship from the poop, while the actual control is made effective under the deck. As all of the communications are carried on by means of a cable of four strands, it is evident that the risks of derangement or damage are much less than with mechanical connections or with a

telemotor. Each position from which it may be desired to control the ship is provided with a transmitter actuated by hand by the officer of the watch. This signal is then transmitted to an indicator. When the helmsman has executed the order thus transmitted, the automatic helm indicator shows to the officer the angle taken by the helm. He can thus be immediately assured that his order has been received and executed. The transmitter is provided with a disk of unpolished glass carrying figures, and is lighted in the interior of the instrument. The order is received on an indicator exactly similar to that which indicates the position of the helm.



PATENT HELM INDICATOR.

The third application of this system is a form of telegraph intended to transmit the orders of the officer of the watch to the engine room. It may be employed for example to indicate the desired number of revolutions of the engine. By means of an ingenious device, two indicators show all the numbers from 20 to 129. The receiving disk is provided with two columns of figures. That on the left indicates tens and that on the right units. A black line rises and falls before each of these scales. Its movement is obtained very simply by a relay. The system permits the transmission of more than 100 signals on a single disk, at the same time preserving great precision of transmission. Such a result could clearly not be obtained by an index of the ordinary kind.

QUERIES AND ANSWERS.

Q. 262.—Will you please be so kind as to inform me through Queries and Answer column, if there is a jump spark so-called, on gasoline engines, that will not short circuit, or, in other words, circuit proof, and where I may be able to obtain same. As you no doubt know, this can be done with the make-and-break system, but with the jump spark if any moisture whatever gets on the wire or plug it will short circuit and the spark will not go where it should. Also, if a magneto can be used on a jump spark the same as on a break-and-make? J. L. T.

A.—By using rubber covered wire and taping all connections with a good insulating compound, a jump spark will be as reliable as the make-and-break sparkers.

There is a device made in England by which a spark will pass between the proper parts of a plug when same is immersed in water. An expert recently asked for quotations on this and received a price list on ordinary spark coils with the information that the device was too costly. As this scheme increased the voltage of the spark circuit it may be there are unknown difficulties to be met, but as he expects in the near future to try this out and give the results in an article in MARINE ENGINEERING, it will be well to look out for the article. A magneto or dynamo can be used with a jump spark coil successfully, but the coil must be wound for this purpose as one wound and insulated for battery current will be too apt to break down with the other sources of current.

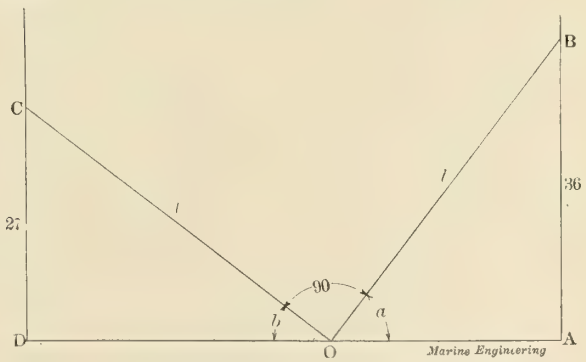
Q. 263.—In examination for admittance to one of the engineering schools near here the following example was given out:

A ladder whose foot rests in a fixed position just reaches a window 36 feet from the ground on one side of the street, or when turned about its foot it just reaches over on the other side 27 feet from the ground. The two positions of the ladder are at right angles to each other. Find the length of the ladder and the width of the street.

I am a marine engineer, and, with other engineers, we have debated as to the correct solution of this problem. Kindly inform us through your valuable columns the correct method of working this kind of examples. This was referred to you at the request of several readers of your magazine, including myself.

J. W. S.

A.—There are several different solutions to this problem, but the one which appears to us the simplest is as follows:



We assume that you are acquainted with some of the fundamental properties of an angle, such as the sin and cosin. Referring to the figure, the angle about O, the base of the ladder, from A to D is 180 degrees. Now by your statement angle BOC is 90 degrees; therefore $a + b = 90°$, or $a = 90° - b$. That is to say, b and a are complimentary to each other.

Therefore sin a = cos b.

Also by your statement the lines *AB* and *CD* are perpendicular to *AD*. Therefore the triangles *OAB* and *ODC* are right angle triangles.

Therefore sin $a = 36 \div l$, but as sin $a =$ cosin b, cos $b = 36 \div l$.

Now l, the hypothenuse, is a fixed quantity.

Therefore $OD = 36$. Similarly we find that $OA = 27$.

In a right angle triangle the sum of the squares of the two legs equals the square of the hypothenuse, $OA^2 + AB^2 = l^2$, or $27^2 + 36^2 = l^2$.

Therefore $l = \sqrt{(27 \times 27) + (36 \times 36)} = \sqrt{2{,}025} = 45$.

Q. 266.—I have two questions I would like to have answered. Why is it that a twin-screw vessel having the screws turning outboard will give more speed to that boat than one whose propellers turn inboard with the same degree of pitch, same diameter and same number of revolutions per minute? I would like to know how the degree of pitch of a screw propeller is found. Hoping these question will be answered. H. F. H.

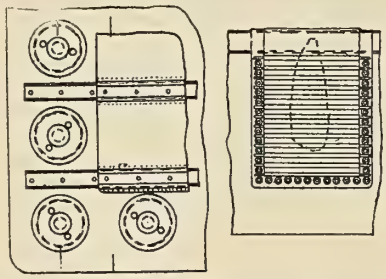
A.—The general practice now appears to be in favor of the outboard turning screw. The British navy has adopted this method. The reason for the increased speed sometimes observed has never yet been satisfactorily explained, and is not subject to mathematical treatment; one theory advanced is that as the blades always carry down with them more or less air, if they turn outboard the quantity of air is less, as it will be forced out by the solid water surrounding, while if they turn inboard the proximity of the side of the ship, with its attendant eddies and broken water, hinders the free run of water to the blade. Thus, with the former arrangement the wheel is working in more solid water.

Your second question we presume is for determining the pitch from the propeller itself, and not from the design. Lay the propeller with the after face down. Establish the center line of shaft by means of a thin piece of wood wedged across the bore. From this center measure on a straight edge laid across the face of the hub and over a blade, some even dimension in feet to about the center of the blade; lay this distance off at two points on the blade, one near the entering edge the other near the following edge and at a conveniently even number of inches apart. Measure down vertically from the straight edge leveled across the face of the hub to these two points. Let us assume that we took these two points on the blade at a distance of 3 feet from the center line and that the propeller is 12 feet in diameter; that the distance between the two points on the blade is 16 inches; and that the vertical distances down are 2.3 and 12.9 inches respectively: then we proceed as follows:

The horizontal distance between the two points on the blade is found by rules of the right angle triangle, the hypothenuse is 16 inches, one leg is $12.9 - 2.3 = 10.6$ inches, therefore the horizontal distance, the other leg, is $\sqrt{16^2 - 10.6^2} = 12$ inches. Now at a radius of 3 feet the circumference is $3.1416 \times 3 \times 2 = 18.89$ feet nearly, and on this radius the pitch for a distance of 12 inches we have found to be 10.6 inches. As 12 inches is $\frac{1}{18.89}$ of the whole circumference, the pitch for the entire wheel must be $\frac{10.6'' \times 18.89}{12} = 16.7$ feet, or 16 feet 8 inches. It is well to find the pitch of the surface near the hub and also near the tip, as on some wheels they are different.

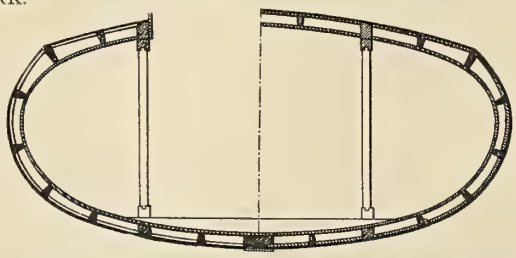
SELECTED MARINE PATENTS.

770,078. MAGNETIC CURTAIN FOR COVERING LEAKS IN SHIPS. LUDWIG KRUGER, SONDERBURG, GERMANY.



Claim.—2. A flexible curtain for covering holes in the side of a ship, composed of a sheet of rubber reinforced by a plurality of iron bars secured upon said cloth and covered by a canvas, the edges of said rubber cloth being provided with pieces of magnetized steel the outer piece being concave and the inner piece being convex, snugly fitting in the cavity of the outer piece, both being united by screws, rivets, or the like, and clamping between them the rubber cloth. Two claims.

770,838. VESSEL-HULL. HENRY N. WHITTELSEY, NEW YORK.



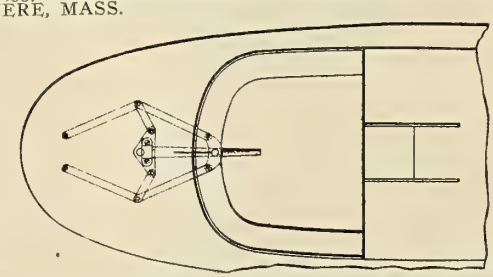
Claim.—1. In a vessel-hull, the combination with longitudinal members, outside frames and inner frames, said outside frames being substantially flush with the outer edges of the longitudinal members, of planking of substantially the same width as the spacing of the longitudinal members and fastened along its abutting edges to such longitudinal members.

2. In a vessel-hull, the combination of the keel outside frames secured thereto on each side thereof, continuous inner frames passing over the keel, longitudinal members between the frames, and planking the same width as the spacing of the longitudinal members fastened along its abutting edges to said longitudinal members.

3. In a vessel-hull, the combination of longitudinal members, continuous inner frames curving from the sides to the deck, outside frames and deck-carlines meeting at an angle at the gunwale, and a longitudinal member supporting the joints and of greater depth than those immediately above and below it.

4. In a vessel-hull, the combination with longitudinal members, outside frames and inner frames, said outside frames being notched into the longitudinal members, of planking fastened along its abutting edges to such longitudinal members. Four claims.

771,537. STEERING-GEAR. PILLSBURY C. DOLLIVER, REVERE, MASS.



Claim.—1. In a steering-gear, a rudder-post, two oppositely-disposed toggle-levers connected thereto, a tiller pivoted to move horizontally, and connections between said tiller and each toggle-lever, whereby the motion of the tiller is communicated to the rudder-post through the toggle-levers.

2. In a steering-gear, a rudder-post, two oppositely-disposed toggle-levers situated in the same plane and extending in the same general direction, a tiller pivoted to move horizontally, and connections between said tiller and each toggle-lever. Fourteen claims.

772,309. AUXILIARY STEERING-GEAR FOR SHIPS. EARL C. AKERS, PORT HURON, MICH.

Claim.—1. A ship's steering-gear comprising a main steering mechanism operatively connected with the rudder, a spare steering-gear normally disconnected from the rudder, and means operating to automatically release said main steering mechanism from the rudder when said spare gear is operatively connected with the rudder. Twenty-two claims.

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" 84, Jas. H. Kopf, 308 Adams St., Mobile, Ala.
" 85, Samuel K. Kissack, 442 State St., Alpena, Mich.
" 86, S. A. Smith, 737 Menekannee Ave., Marinette, Wis.
" 87, Geo. B. Milne, 237 W. Canfield Ave., Detroit, Mich.
" 88, C. O. Chapman, S. B. Canal, Sturgeon Bay, Wis.
" 89, L. O. Willix, 89 Elizabeth St., Ogdensburg, N. Y.
" 91, R. Davidson, 17 Fairfield Ave., Har. Sta., Ashtabula, O.
" 92, H. E. McArthur, 16 Abstract Bldg., Saginaw, Mich.
" 93, M. E. Davis, 929 D St., N. W., Washington, D. C.
" 94, George R. Jones, Box 222, Washington, N. C.
" 95, P. J. McMahon, P. O. Box 199, Key West, Fla.
" 100, Thos. F. Sullivan, Honolulu, H. I.
" 101, J. K. Cotton, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., So. Haven, Mich.
" 103, A. E. Pittman, P. O. Box 378, Newbern, N. C.

TRADE PUBLICATIONS.

Worthington Meters is the title of a neat eight-page folder just issued by Henry R. Worthington, 114 to 118 Liberty street, New York, N. Y.

The Buffalo Improved Ventilator and the Buffalo Disk Wheels are the two latest publications issued by the Buffalo Forge Company, Buffalo, N. Y. They are pocket size, handsomely printed, and neatly bound in illuminated paper cover. Each catalogue comprises sixteen pages and is thoroughly illustrated. The text in each covers the subject concisely and is accompanied by the necessary tables to make the text of scientific value.

Spiral-Riveted Pipe is the title of a neat catalogue issued by the American Spiral Pipe Works, 1173 South Paulina street, Chicago, Ill. In addition to a full description of the construction of this pipe and many illustrations regarding it, there are several testimonials, pictures showing trying conditions under which the pipe is used for various purposes, together with many tables relating to sizes, horse power, flow of liquid, etc.

The American Tool Works Company, Cincinnati, Ohio, is issuing a pamphlet illustrating its several types of improved metal-working machinery. The pamphlet states that these works have become so large that each type of machine manufactured is built in a separate and distinct department. Lathes, metal planers, drills, drill presses, boring and turning mills are among the articles manufactured by this company.

Bell's steam hammers will be found exceptionally well illustrated and described in an unusually handsome catalogue issued by the David Bell Engineering Works, Buffalo, N. Y. It describes steam hammers in ten sizes, from 250 to 1,600 pounds falling weight. The catalogue is neatly bound in heavy red cover and fully illustrates the many types of hammers which this company manufactures. The illustrations are large and very clear, giving a comprehensive idea of the manner in which the hammers are constructed and operated.

Dodge and Day, Nicetown, Philadelphia, Pa., are issuing a pamphlet of interest to shipbuilders and manufacturers, minutely describing the object and scope of their betterment reports. The pamphlet states that the betterment reports "are written with two things in view: a policy to follow for future growth and the immediate betterment of present conditions with the least possible outlay." In other words, the firm gives its patrons the benefit of expert advice on the subject of systematizing, reducing expenses, obtaining additional business, and making "betterments" in general.

The James Reilly Repair and Supply Company, 229 and 230 West street, New York, N. Y., is mailing a pamphlet calling attention to the facilities the company possesses for the manufacture of all classes of engineering specialties. The company is located on the water front, thus giving it a convenient location for repairs to steamships, yachts, and tugs. The pamphlet illustrates and describes evaporators, coil feed-water heaters, filters, grease extractors, side lights, grease cups, condenser tools and packing, ship pumps, ventilating systems, brass, copper, and iron railings and fittings, electric light and power plants, and other steamship and yacht auxiliaries.

The boat catalogue just issued by the Matthews Boat Company, Bascom, Ohio, is one of the most beautifully printed catalogues which has been received by MARINE ENGINEERING for many months, both in its binding and typographical effect. It comprises 68 pages, and has from one to four or more illustrations on nearly every page. The illustrations include boats of all sizes and types up to yachts of considerable size, including open launches of all kinds, also half-cabin and full-cabin yachts and launches. In addition to boats, the text gives a great deal of information which is necessary for every launch owner to know, including the care of engines and boats, rules of navigation, nautical measurements, racing rules, etc. We believe a nominal charge of ten cents is made for copies of the catalogue and stamps can be sent instead of silver.

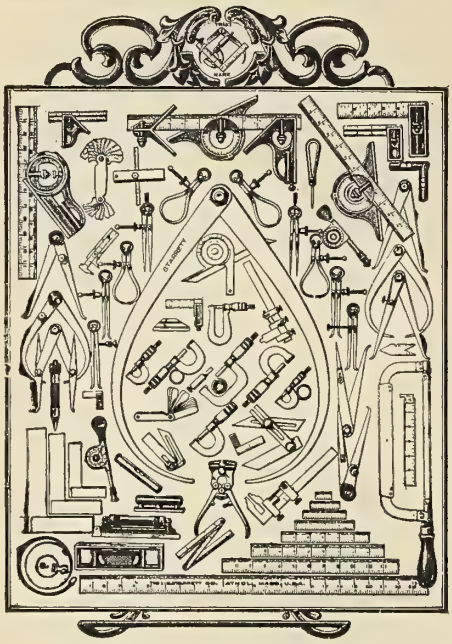
The Laidlaw-Dunn-Gordon Company, 114 Liberty street, New York, N. Y., is distributing Bulletin No. L 509, describing the Meyer-Gear air compressors with rolling-mill frames.

The Importance of Preserving Exposed Woodwork is the title of a pamphlet issued by Samuel Cabot, 70 Kilby street, Boston, Mass. It refers especially to the preparation "Conservo," manufactured by this company. This compound is described, and full information is given regarding its application and its action upon the wood. This preparation is shown to be particularly desirable for use on ship and boat timbers and planking; indeed, wood of all kinds that is open to the corrosive effect of the elements.

A folder, entitled "A Talk on Packing," is mailed by the Republic Rubber Company, Youngstown, Ohio. The folder states that the company's Searchlight packing is the only one-sheet packing manufactured that will not harden under high steam pressure. In another folder this company calls attention to the cross-arm tubular gasket. This gasket has a brass wire mesh running through the center, so that when heat and pressure are applied the wire is embedded in the rubber. The joint is covered with annealed copper vulcanizing sleeve.

Centrifugal pumping machinery is minutely described and handsomely illustrated in the latest catalogue of the Kingsford Foundry and Machine Works, Oswego, N. Y. The catalogue states that the centrifugal pumps of this company are the only ones on the market with the single or side suction that contain the features of self-oiling bearings, solid scrolls or shells, removable suction head (which permits of examination of the interior of the pump without removal from the base or bed), large shafts and pulleys, and an improved stuffing box that will remain tight under the most trying conditions. Different parts are made to template, so that all parts fit where they are intended. Minute instructions are given intending purchasers as to the size and style of pumps suitable to various purposes, and mention is made of the marine engines and fire-tube boilers made by this company.

The American Blower Company, Detroit, Mich., issues a set of seven catalogues which are not only exceptionally fine specimens of printing, but which are of much value in their several lines of engineering. They cover the subject of mechanical draft, the heating and ventilating of manufacturing establishments, American Blower Company steel plate fans for heating, ventilating, and drying plants, forced and induced draft apparatus, etc., American Blower Company hot-blast heaters for the heating and ventilating of public buildings, American Blower Company disk ventilating fans, American Blower Company pressure volume blowers, and American Blower Company exhaust fans. Each catalogue is completely illustrated and with the text, tables, etc., is a valuable contribution to engineering trade publications. Copies of any of the catalogues can be had by the readers of MARINE ENGINEERING upon application to the company.



The Starrett Catalogue No. 17 L will give you the latest tool news.

The L. S. STARRETT CO.
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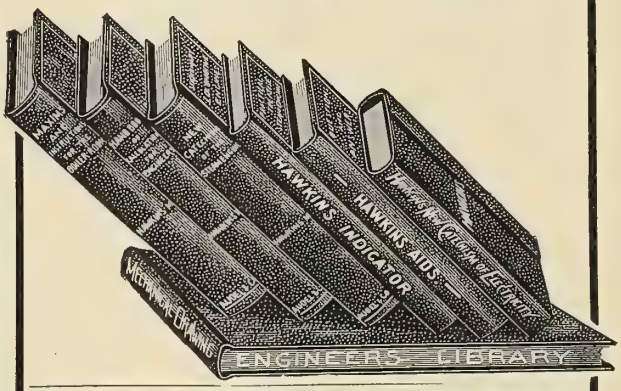

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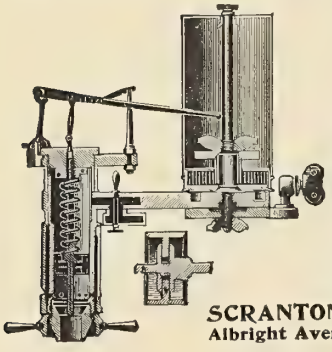

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Got them of us, at a price so low that he was astonished. YOU can do the same, and should send for our catalogue, which not only describes these instruments fully, but gives $ $ $ worth of instructions in their use. It is free

We make also **Steam Pumps, Steam Separators, Oil Extractors, Shaking Grates, and Furnace Blowers,** all in the catalogue

SCRANTON STEAM PUMP CO.
Albright Avenue, Scranton, Pa.

DIXON

THERE are seven degrees of hardness in Dixon's Graphite Cup Greases. The softest are for use on light high-speed machinery; the harder grades for heavier work. In making these greases, we use only Dixon's Pure Flake Graphite. Ask for booklet 75-I.

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These are the capitals of a vast territory. A region which is an empire in itself, with resources sufficient to sustain a population of three empires.

For particulars as how best to reach this new empire from points east of Chicago and St. Louis, call on the nearest agent of the

NEW YORK CENTRAL LINES.

A copy of the 52-page Illustrated Catalogue of the "Four-Track Series," New York Central's books of travel and education, will be sent free to any address on receipt of a two-cent stamp, by George H. Daniels, General Passenger Agent, New York Central & Hudson River Railroad, Grand Central Station, New York.

The latest short story of engineers, issued by Wyman and Gordon, Worcester, Mass., is devoted to the life and work of James B. Eads.

The Sawyer-Man Electric Company, 510 West 23d street, New York, N. Y., is sending out a pamphlet describing the various forms of electric lamps it manufactures. Much information is given on the subject of light distribution, value of voltage regulation, etc.

Type H Induction Motors is the subject matter of circular No. 1056, just issued by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. This is a revised publication and supersedes a previously-published circular which is now out of print. The circular comprises twelve pages very handsomely printed and thoroughly illustrated.

Every user of steam brass goods should send for a copy of the fifth edition and revised catalogue No. 7, issued by the William Powell Company, 2525 to 2531 Spring Grove avenue, Cincinnati, Ohio. The catalogue is pocket size and comprises about 175 pages, including index. It gives a great deal of information regarding the large line of engine and boiler-room specialties which this company manufactures, and contains a great deal of other valuable information.

Every reader of MARINE ENGINEERING interested in steam engines will want a copy of Bulletin No. 1 just issued by the Rotary Engine Company, 135 South Second street, Philadelphia, Pa. A number of line drawings are given, showing in full detail the internal arrangement of this engine. The bulletin comprises 16 pages. Although the text describes the engine for direct-connected purposes, the engine is also well adapted to propelling boats and vessels.

William T. Bonner and Company, 53 State street, Boston, Mass., are mailing a folder illustrating and describing the Klinger reflex water gauges and "Wiltbonco" gauge mountings. The folder states that whereas, with the ordinary gauge glass tube, one cannot tell whether it is full or empty, when filled with water the reflex gauge appears black. When empty it instantly shows white, thus rendering mistakes impossible. The heavy marine patterns of the "Wiltbonco" gauge mountings are used in a number of ships in the United States Navy, as well as in the merchant service.

Motor-Operated Valves is the title of Bulletin 34, issued by the Northern Electrical Manufacturing Company, Madison, Wis. The bulletin illustrates and describes the advantages of operating valves by motor power. It describes the Northern back-geared motor, which is claimed gives the required low speed without being larger or much more expensive than a standard speed motor, and does not require that the valve standard be supplied with special conveniences, bearings and shafts for an intermediate set of gears. The armature shaft is geared to the countershaft, supported by the frame of the motor. The whole combination is self-contained. The company is also mailing a pamphlet entitled Northern Small Motors for the economical and convenient operation of machines and tools.

WATCH THIS SPACE FOR OUR NUMEROUS SPECIALTIES.

WALWORTH MFG. CO. TOOLS and SUPPLIES for STEAM WATER and GAS USERS BOSTON MASS.

SOLE MANUFACTURERS OF THE FOLLOWING:

Stillson Pipe Wrench.
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Hall's Tapping Machines for Street Mains
Smith Friction Hand Tools.
Drill Stocks,
Combination Socket Wrench with Drill Auger Bit,
Screw Driver Stock, &c.
Taps, Reamers and Drills.

JOBBERS SELL THEM—IF YOURS DON'T, WRITE.
New York, Park Row Building. WALWORTH MFG. CO., Boston, 128 Federal Street.
Write for our BLUE CATALOGUE "D." showing complete line of engineers' pipe fitting tools.

The Powers system of carrying and launching lifeboats is described in a pamphlet issued by Wilbur F. Powers, 318 North Fourth street, Camden, N. J.

Those of our readers interested in the subject of heating appliances will find an interesting catalogue in the one issued by the Economy Car Heating Company, 281 St. John street, Portland, Me., describing the Economy car-heating system.

The Heating and Ventilating of Factory Buildings is the title of a paper recently read at the annual convention of the American Foundrymen's Association by W. H. Carrier, M.E., copies of which can be had from the Buffalo Forge Company, Buffalo, N. Y.

The Flinn Steam Trap, which is especially designed for use on steam vessels, is illustrated and concisely described in a folder issued by Richard J. Flinn, West Roxbury, Mass. A sectional view shows why this trap is especially adapted for marine work.

Electrical and Steam Machinery is the title of a pocket-sized catalogue printed by Rossiter, MacGovern and Company, 17 Battery place, New York city. There are thirty-six pages devoted to a list of electrical machines, engines, boilers, and a great variety of other apparatus which this company has for sale.

The C. W. Hunt Company, West New Brighton, Staten Island, N. Y., issues pamphlet No. 037 illustrating and describing in a few words the cooling towers and elevators, trolleys, railways, hoists, ropes, blocks, sheaves, electric motors, and a number of other specialties which this company manufactures.

Wire Rope is the title of the latest catalogue of the American Steel and Wire Company, The Rookery, Chicago. The many uses of wire rope in marine work and in manufacturing plants of all kinds are fully explained. The company manufactures many varieties of rope. Minute instructions are given for splicing wire ropes.

The Hoshor-Platt Company, 120 Liberty street, New York, N. Y., describes in its latest catalogue the industrial railways, hoisting engines, conveyors, mast and gaff fittings, steel cables, Manilla rope, and other machinery and supplies. The catalogue enters into complete details regarding every article listed, and is profusely illustrated.

Emil Frank, 1123 Broadway, New York, N. Y., has issued a folder describing Remanit pipe covering, of which he is sole agent for the United States and Canada. The folder states that Remanit is a non-heat-conductive covering composed of carbonized silk, used for covering steam pipes, hot air, and water pipes, also for covering cold-water pipes, refrigerators, etc.

Milling machines and milling cutters are described in an illustrated catalogue issued by the Hess Machine Company, Fifteenth and Chestnut streets, Philadelphia, Pa. The company states that it makes a specialty of heavy milling, fast milling, and combined heavy and fast milling machines. Motor drives will be furnished with machines, designed to suit the individual case.

E. F. Houghton and Company, 240-250 West Somerset street, Philadelphia, Pa., are mailing a folder describing and illustrating the "Marck" steam trap. This trap has but one movable part, and the valve is actuated by the expanding and contracting of a Marck steel tube. They state that they send out traps on thirty days' trial, to be returned at their expense if unsatisfactory.

Reynolds and Company, 418 Perry-Payne Building, Cleveland, Ohio, are mailing a folder describing the Reynolds feed-water heater and purifier. The folder states that the invention has for its object the heating of feed water for the boiler, and the removal of a greater part of the impurities contained therein, before the heated water is discharged into the boiler.

The Crandall Packing Company, 123 Liberty street, New York, is mailing a calendar bound in pamphlet form, calling attention to its round Helios gaskets, white sheet packing, new model ring for high-speed engines, expansion coil packing for gas and ammonia, and red tubular gaskets. The back of the calendar is a post card which may be used to bring a salesman or specifications. A calendar will be issued every month.

If It Were A Fact...

which, under proper conditions, it is not—that white lead covers better than **ZINC WHITE;** still in view of its greater spreading power and greater durability, **ZINC WHITE** *would be by far the more economical paint.* Any high-grade combination paint based on **ZINC WHITE** will cover more area, pound for pound, than the best white lead, will cover this area equally well—will cover it more pleasingly and more economically and will keep it effectively covered much longer. One does not need to go beyond the facts in possession of any paint manufacturer to prove that **ZINC WHITE** is the vital element in successful paint making.

FREE: Our Practical Pamphlets:

"The Paint Question,"
"Paints in Architecture,"
"Specifications for Architects,"
"House Paints: A Common Sense Talk About Them,"
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The New Jersey Zinc Co.

71 Broadway
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WE DO NOT GRIND ZINC IN OIL. LIST OF MANUFACTURERS OF ZINC WHITE PAINTS WILL BE FURNISHED ON REQUEST.

CONDENSER TUBES
last longest if made of
"BENEDICT = NICKEL"
ELECTROLYSIS is positively resisted because "Benedict-Nickel" is an alloy of nickel and copper.
CORROSION is impossible, as the tubing is so perfectly homogeneous.
Our treatise on "Electrolysis of Condenser Tubes" is very valuable and costs you nothing. Send for it.
BENEDICT & BURNHAM MFG. CO.
WATERBURY, CONN.
New York, 253 Broadway Boston, 172 High St.

The Frank Mossberg Company, Attleboro, Mass., issues a catalogue entitled "Our Facilities and What We Do." This includes quite a line of automatic machinery for various purposes.

The H. W. Johns-Manville Company, 100 William street, New York, is distributing a large mailing card regarding "Wasted Power." Reference is made to this company's asbestos fire felt covering.

The White Craft and Power Company, Port Richmond, Staten Island, N. Y., successor to Reeves and White, is sending out an illustrated pamphlet describing its engines, yachts, and launches, also giving prices on new work ordered.

The Coatesville Boiler Works, Coatesville, Pa., are mailing an illustrated catalogue describing self-supporting wrought-steel stacks, standpipes, corrugated furnace boilers, garbage-plant digestors, separators, etc. The illustrations give an excellent idea of the quality and variety of output.

The Pope Manufacturing Company, Hartford, Conn., has reissued the Pope bicycle daily leaf calendar, which for many years was a prominent feature on almost every business man's desk. One of these calendars will be sent to any inquirer upon receipt of five two-cent stamps.

C. W. Hunt Company, West New Brighton, Staten Island, N. Y., describes in Pamphlet .037 steam and electric hoisting engines, conveyors, industrial railways, locomotives, blocks and sheaves, parabolic boom towers, mast and gaff fittings and other articles.

The Best Story Ever Published

of an engineer's life below the grating is

The Professor on Shipboard, - - *Price, $1.00*

Notice our combination book offers. Sent on receipt of price by

MARINE ENGINEERING
309 Broadway, New York City

BUSINESS NOTES.

MARINE HARDWARE.—Users of marine hardware will find a very complete and up-to-date line of goods manufactured by the Thomas Laughlin Company, 143 to 151 Fore street, Portland, Me. This company, we are informed, has recently more than doubled its capacity in every line, and is continually adding new buildings and machinery in order to keep up with the demands for up-to-date marine hardware. A list of the company's specialties, given in a very large and handsome cata logue which the company has just published, covers nearly ten pages, and includes almost everything that can be asked for, such as anchors of all kinds, blocks, boat fittings, chains in all varieties, cleats, everything needed in the line of deck fittings, hinges, hooks, lamps and fittings, steerers, etc. The catalogue in question is bound in stiff cloth and comprises 290 pages of text, illustrations, and tables. No builder of boats, launches, or small yachts could very well be without such a very complete catalogue as this is.

REMOVAL OF THE RACINE BOAT MANUFACTURING COMPANY.—It will be recalled that the plant of the Racine Boat Manufacturing Company, Racine, Wis., was destroyed by fire last summer. After looking about, the best position for the rebuilding of the business on the Great Lakes which the company could find was at Muskegon, Mich., and the new plant is almost ready to begin turning out the well-known boats of this company. The new location comprises ten acres, and has connected with it three piers each 550 feet long. Deep water leads to the two slips which will allow the largest boats on the lake to tie up at the shops for repairs. Everything will be in working order in the new establishment, it is hoped, before January 20. The new plant will have much larger capacity than the old plant had, enabling the company to considerably enlarge its facilities for building launches, yachts, and boats of all kinds and sizes.

COMPETENT HELP

Marine Engineering Employment Bureau is prepared to put **Builders of Vessels and Marine Machinery** into communication with men whose records have been investigated. **Ship and Yacht Owners** can be provided in the same way with competent men whose records have been thoroughly looked up.

Employers Seeking Help or **Men Seeking Positions**

Can secure full information by addressing:

MARINE ENGINEERING EMPLOYMENT BUREAU
309 Broadway, New York, N. Y.

MR. GEORGE CROUSE COOK, naval architect, has removed his offices from 130 Water street to 52 Broadway, New York city.

AMERICAN PRESSED STEEL OFFICES.—A card is sent out by the American Pressed Steel Company, announcing that its sales offices have been moved to 402 Arcade building, Philadelphia, Pa., and that Mr. R. M. Baily has been appointed sales manager.

PARSONS STEAM TURBINES.—Mr. George Westinghouse makes the important announcement that he has acquired for the Westinghouse Machine Company, Pittsburg, Pa., from Mr. C. A. Parsons, the full rights to manufacture in the United States and Canada the well-known Parsons steam turbines for all purposes, including marine propulsion, and that a special department will be organized at the works for the introduction of this engine, in order to more effectively promote its use upon all classes of vessels. Mr. Westinghouse adds: "The steam turbine is not a new or untried invention. There are half a million horse power of Parsons steam turbines in daily operation in different parts of the world; 84,000 horse power of these are in steam vessels. I have made a broad investigation of this question, with the result that the Parsons turbine is the one with which I have concluded to ally my interests. We shall build up a great marine turbine industry in the United States. The importance of the marine turbine has not been overestimated, and it is long past the stage of experiment. For passenger ships, freight ships, yachts, and for battleships, not less than for torpedo boats, the turbine is unquestionably the best engine. For pleasure craft the turbine surpasses all other forms of engine, because of its absolute freedom from vibration. Its compactness recommends it for all classes of vessels. In torpedo boats the saving of room is needed to accommodate other machinery. In naval cruisers and battleships, the engines lie so much closer to the ship's keel as to make them far less likely to be injured by the enemy's shots. We need not call the turbine the engine of the future; it is decidedly the engine of the present."

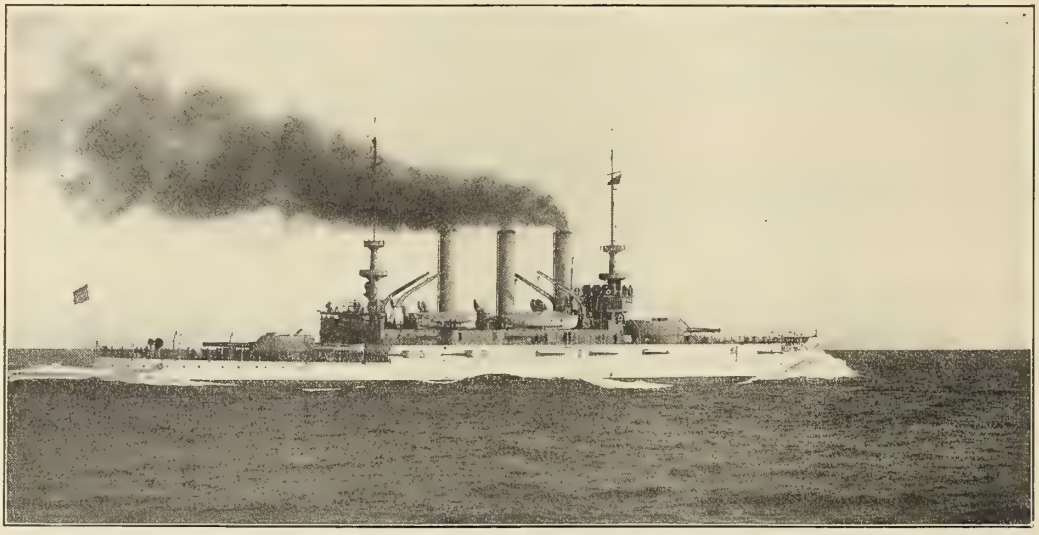
GREAT BARGAINS IN COMPOUND ENGINES.—As will be seen by an advertisement elsewhere, the Reeves Engine Company, 85 Liberty street, New York, N. Y., advertises a great bargain in two 7 1-2 and 17 by 10 Reeves fore-and-aft engines.

ROPES AND FITTINGS.—The Durable Wire Rope Company has leased for a term of years the remodeled stores, 26-30 Atlantic avenue, at the head of Lewis wharf, Boston, Mass., where much more ample facilities are had for carrying in stock a full line of Durable wire rope for all purposes, as well as other ropes and fittings.

STANDARD MACHINERY COMPANY.—The Standard Machinery Company has acquired the business and plant of the Mossberg and Granville Manufacturing Company, and will continue the manufacture of power presses, plain and automatic drop presses, draw benches, Mossberg roller bearings, etc., at the same location, Beverly street, Providence, R. I.

NEW LAUNCH BUILDING CONCERN.—The Chase Pulley Company announces that it has established a boat-building department at 201 Pitman street, Providence, R. I. The company has secured the services of Mr. Charles B. Hadley as superintendent of this department. Mr. Hadley was with the Herreshoff Manufacturing Company for seven years, having charge of the east construction shop. The new shops are fully equipped with tools and machinery for getting out work in the quickest and most economical manner, and a force of skilled boat builders insures first-class work at reasonable prices. These shops are situated on the Seekonk river, near Red Bridge, affording easy access to customers who may desire to inspect the work at all stages of construction. The company will not at first enter upon the building of any particular type of boat, but may later on. It is prepared to build all kinds of boats up to 70 feet in length. The company is also prepared to haul out and store boats during the winter months, and to fit them out in the spring.

U. S. BATTLESHIP MISSOURI



Piston Rods and Valve Stems of main and auxiliary engines fitted with

UNITED STATES METALLIC PACKINGS

SEND FOR OUR CATALOGUE.

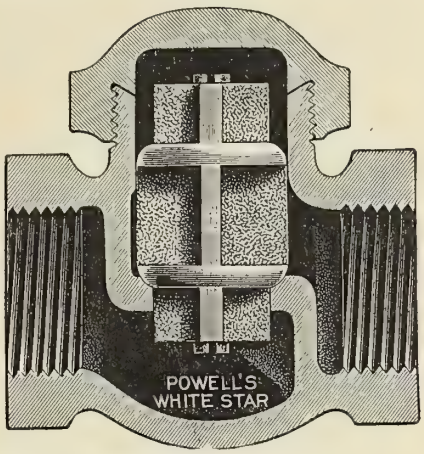
THE UNITED STATES METALLIC PACKING COMPANY

427 North Thirteenth Street, Philadelphia, Pa.

509 Great Northern Building, Chicago, Ill. MORAN BROTHERS, Seattle, Wash.

"WHITE STAR" CHECK VALVE

Reversible and Re-Grinding



Disks in one piece with double seating heads.
Both ends made to gauge.
Economical because reversible and made of best material.
Will withstand a temperature of 2,000 degrees.
Simple and convenient—Re-grinding effected by inserting screw-driver in slot at either end of disk and rotating back and forth.

THE WM. POWELL CO.

Everything in the steam line for the boiler and engine room.

CINCINNATI, OHIO, U. S. A.

New York Agent: H. H. BEALS, 51 Cliff St.
Philadelphia Agent: C. J. RAINEAR & CO., 515 Arch St

THE STORY OF PHOEBE SNOW.

If you have ever taken a railroad trip you will enjoy the "Story of Phoebe Snow," which describes in a series of dainty pictures the experiences of a pretty girl who went to Buffalo. The illustrations are in seven colors, each reproducing a design of the girl in white which the Lackawanna Railroad has made so familiar in the last few months. The booklet has a particularly pleasing cover and will afford considerable amusement beside giving information which every traveler ought to know. It will be sent in response to request, accompanied by two cents in stamps, to T. W. Lee, General Passenger Agent, New York City.

MARCK STEAM TRAP.—E. F. Houghton and Company, Third and Somerset streets, Philadelphia, Pa., are making a very liberal offer to users of steam traps. The offer is, that Marck steam traps will be forwarded to any one who has use for these specialties, and if the traps do not give satisfaction and make a large saving in the fuel bills, they can be returned within thirty days and no charge will be made. This trap has been on the market for many years in Europe, and has been sold in large numbers in this country during the past six years.

THE DIAMOND DRILL AND MACHINE COMPANY, Birdsboro, Pa., has exclusive patent rights in the United States for Wagner cold saw cutting-off machines. The company makes steel castings and the Jackson belt-lacing machine, and has recently added extensive improvements to its plant. A number of casting orders have been received from railroads, and with the increased capacity it will be in good shape to turn out orders rapidly. The tools in the finishing and machine shops are up to date, and a number of practical labor-saving devices are in use.

THE NICHOLSON SHIP LOG.—Captain Rubelli, master of steamship *Colonel E. L. Drake*, recently wrote to the Nicholson Ship Log Company, Cleveland, Ohio, as follows: "I have recommended the use of your log to the ships of the J. M. Guffy Petroleum Company, the steamship *Strombers* of the Shell Transport and Trading Company of London, and the steamship *Northam*. I also gave the captain of the *Strombers* one of your record charts to take to England to show his people. Will also recommend that this log be installed on our new ship the *Captain Lucas*. On our last trip to Port Arthur, Texas, and return we made a run of 505 miles, from Tortugas lighthouse to Ship Shoals lighthouse in the Gulf of Mexico, the log registering one and one-half miles more."

THE UNITED STATES INDESTRUCTIBLE GASKET COMPANY, 8 South William street, New York, N. Y., states that the corrugations on its metal gasket are, as far as resisting the pressure of the flange unions, a series of concentric arches which approach flattening only under great pressure. The summits of the corrugations or arches form a series of dams over which the air, steam, water, oil, or other liquid cannot pass. As to resilience, the company says that the tests in the United States Navy showed that where a line of pipe, coupled with flange unions and packed with this gasket, was purposely forced out of line, that the gasket on one side, by the unusual pressure, flattened considerably more than on the other side, the corrugations of which seemed to spring back to their former shape, thus holding the joint tight all around. This, of course, was a very radical form of expansion on one side and contraction on the other. In an ordinary run of pipe the company says that it will be found that these gaskets, especially where they are not set too tight, will take care of any expansion and contraction, and that the cost is materially less than rubber and other destructible packing.

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The Townsend-Downey Shipbuilding Company, Mariners' Harbor, New York, N. Y., which recently went into the hands of a receiver, has reopened its shipyard and on January 2 expects to employ a full force of workmen.

The Loomis-Pettibone Gas Machinery Company, 52 William street, New York, N. Y., has opened the following branch offices: Boston, State Mutual Building; Pittsburg, Farmers' Bank Building; Chicago, First National Bank Building .

The Mosher Water Tube Boiler Company, 1 Broadway, New York, N. Y., states that of four monitors recently built by the United States government, but one, the *Florida,* which was the only one equipped with Mosher water-tube boilers, escaped a financial penalty for not equalling the speed required by the builders' contracts with the government. The Mosher boilers have been installed in eleven torpedo boats and one monitor in the United States Navy, in six torpedo boats in the Russian navy, in two gunboats for Mexico, and in one torpedo boat and one cruiser for Brazil; also in numerous well-known steam yachts. The company claims for its boilers that they are the simplest, lightest, and most compact boilers made; that they can be cleaned, retubed, and repaired without disturbing any pipe connection or removing the casing. Low-stack temperatures, steady water line when under forced draft, rapid steaming, accessibility, and freedom from leaks are among the other desirable features which are claimed for the Mosher boilers.

White Star Valves.—The William Powell Company, 2525 Spring Grove avenue, Cincinnati, Ohio, makes the following claims as to special features of the White Star valves which it manufactures: Their construction is simplicity itself; they are made to a gauge in all their parts, and of the best of materials. They are unequaled for durability; they are handsome and symmetrical; they control fluids perfectly; disks are not only re-grinding, but are reversible. The "Powelium" white bronze, of which the disks are made, is a new alloy, white as silver, and will outwear all other makes of disks. Guaranteed to withstand a temperature of 2,000 degrees. There is a patented mode of securing the bonnet to the body neck. The tighter the union is screwed down on the beveled face, the more the neck thread is expanded into the union nut. The valve stem is accurately guided for regrinding independently of the bonnet. Every valve carries it own lock bar for regrinding.

Vessels Classified.—The American Bureau of Shipping, 66 to 70 Beaver street, New York, N. Y., reports the following vessels recently classified in the Record of American and Foreign Shipping: American screw *Yamasee;* American schooner *Goldsboro;* American schooner *Massasoit;* American schooner *Eleanor F. Bartram;* American schooner *Horace A. Stone;* American schooner *Quinebaug;* American schooner *Luzon;* American tern *Horace P. Shares;* American bark *Edmund Phinney;* American tern *John R. Bergen;* American tern *Mary E. Morse;* American barge *Annie;* American barge *101;* British steamer *Havana;* British steamer *Squid;* British schooner *Albert D. Mills;* British tern *Hiddie Poore;* British tern *Myrtle Leaf;* British tern *Frances;* and British brig *Ocean Belle.*

Portable Ventilators.—In no branch of government service has the matter of ventilation been given such serious consideration as in the navy. The construction of the modern vessel renders it extremely difficult to secure proper ventilation in some portions below the water line. Noticeable for its novelty, among the various methods used to properly ventilate such places, is the portable ventilating set, consisting of a small exhauster of the Monogram type directly connected to an enclosed electric motor. It is very light, moves a large body of air, and is provided with handles for carrying from place to place, enabling the crew to work in any portion of the vessel with comfort, and is but one of the many types of blowers manufactured by the B. F. Sturtevant Company, Boston, Mass.

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TRADE PUBLICATIONS.

Hamilton Drill Presses, with friction tapping attachment, are the subject of a leaflet issued by the Garvin Machine Company, Spring and Varick streets, New York, N. Y.

The Ross Valve Company, Troy, N. Y., is mailing card calendars suitable for use in desk calendar racks. It is stated that the Ross water engine received the highest award at the Pan-American Exposition.

The Crandall Packing Company, 85 Liberty street, New York, N. Y., has issued its latest monthly calendar calling attention to its piston and valve-rod packing, asbestos wick packing, and metal polish paste.

Isaac G. Johnson and Company, Spuyten Duyvil, New York, N. Y., are mailing a circular illustrating among other things one of their cast-steel projectiles after it had passed through a 10-inch reforged Harveyized nickel steel armor plate. The company states that they give careful attention to the development of very hard and tough grades of steel and castings of every description.

Wilson and Silsby, sailmakers, Rowe's Wharf, Boston, Mass., are mailing a handsome picture of the schooner-yacht *Ariadne,* for which they furnished the sails. The firm make sails for vessels of every size, from the smallest catboat to the largest schooner. Except for the firm's card there is no advertising on the picture, which is mounted on cardboard and is suitable for framing.

Riggs and Brother, chronometer and nautical warehousemen, 310 Market street, Philadelphia, Pa., have issued their 1904 nautical almanac. This almanac contains much information of interest to mariners, giving tide tables for more than 100 points, from Eastport, Me., to Key West, Fla., magnetic corrections, pilot regulations, port wardens' rules, and the like. Price 10 cents.

The American Spiral Pipe Works, 1173-1201 South Paulina street, Chicago, Ill., is mailing an illustrated catalogue describing standard and extra heavy pipe, with flanges attached or with bolted joint connections. A list of plain end pipe in all gauges is also included, besides a price list of standard spiral pipe flanges drilled, attached to pipe, also loose from pipe, and bolted joint connections complete. Weir dam measurements, for measuring the flow of water in streams, tables showing the flow of water through nozzles, and other tables form a part of the catalogue.

Joseph T. Ryerson and Son, Chicago, Ill., in No. 4 of Ryerson's New Technical Library, describe Continental boilers with Morison corrugated furnaces, "what they are, where they are, and what they will do." The firm give a long list of buildings and manufacturing plants where the corrugated furnace boilers are in use, including a number of ship and engine works. Among other advantages it is stated that these furnace boilers are economical in first cost because, being self-contained, they are independent of masonry setting, cast-iron fronts, buckstays, tie rods, etc., require little foundation preparations, and can be easily removed from one location to another.

Cincinnati Air and Gas Compressors are described in Pamphlet L-26-A, just issued by the Laidlaw-Dunn-Gordon Company, 114 Liberty street, New York, N. Y. These machines are of medium and small sizes, the steam ends being equipped with plain slide valves and Meyer valve gears, and the air ends with poppet valves. The company states that one of the compressors is of an entirely new type in that the air cylinders are provided both with mechanically-moved valves and with poppet valves, all points in the compression cycle being determined by the mechanically-moved valves with the exception of the opening of the exhaust, which is determined by the poppet valves. It claims that this arrangement combines the positive action, noiseless operation, and durability of mechanically-moved valves with the elasticity of poppet valves, at the same time avoiding the noise and rapid wear of the latter. The pamphlet will be sent upon request to those interested.

When writing to advertisers please refer to MARINE ENGINEERING.

The Buffalo Gasoline Motor Company, Buffalo, N. Y., is mailing a card with a picture of a gasoline launch going at high speed, with the motto "The Speed-Launch Express." Length over all is said to be 26 feet 10 inches, beam 4 feet, speed 12 1-2 miles.

The Edson Manufacturing Company, 255 Atlantic avenue, Boston, Mass., is mailing a card calling attention to its steering gear, pumps, windlasses, and other marine appliances.

The Cancos Manufacturing Company, 142 North Second street, Philadelphia, Pa., is sending out a folder mentioning its Black Squadron ring packing, and stating that it is the only four-wedge, self-setting, adjustable packing on the market. A postal card is attached to send for a free sample of the packing, and a copy of its little book, "The Engineer."

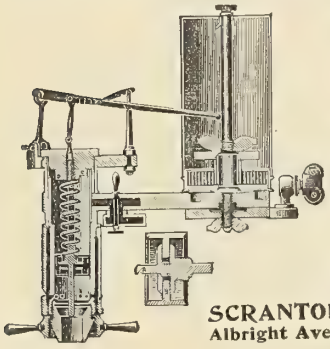
The Under-Feed Stoker Company of America, Marquette Building, Chicago, Ill., is mailing *The Publicity Magazine,* which it publishes. This magazine illustrates and describes the Jones stoker, giving photographs of buildings and manufacturing plants where the stoker is in operation. The stoker can be fitted to boilers already installed as well as to new plants. The company claims that its system is the only method of boiler firing in which the supply of fuel and air is automatically proportioned and controlled by the demand for steam.

Hall Brothers Gas Engine Works, Philadelphia, Pa., is mailing a pamphlet illustrating and describing marine gas engines. Its 1 1-2 and 3-horse-power sizes are of the two-cycle type with single cylinders. The company states that they are of sufficient size in bore and stroke to develop full rated horse power at moderate speed. The four-cycle engines are both single and multi-cylinder according to power, and are built in sizes from 4 to 100 horse power. The four-cylinder engines can be operated by kerosene as well as gasoline.

The Marine Manufacturing and Supply Company, 157-158 South street, New York, N. Y., has issued two illustrated catalogues in pamphlet form, lettered A and B. In these catalogues the company describes marine engineers' and contractors' supplies and specialties. Suction pumps, diaphragm pumps, plunger pumps, force pumps, deluge pumps, ship and yacht pumps, hose, strainers, suction baskets, hose couplings, iron towing bitts, windlasses, capstans, winches, and cordage are among the articles the company deals in.

The 1904 catalogue of the Knowles Steam Pump Works, 114-118 Liberty street, New York, N. Y., is a book of about 150 pages showing nearly half as many full-page illustrations of different types of direct-acting steam pumps for boiler feeding, mine drainage, waterworks service, etc., also electric and belt-driven pumps, artesian well pumps, air compressors, and ammonia pumps, both fly-wheel and direct-acting, jet condensers, relief valves, air and circulating pumps, wrecking pumps, vacuum pumps, sugar-house pumping machinery, and pumping machinery of every type and for every purpose found in engineering work. This catalogue will be sent free to those interested, upon request.

AN ENGINEER WANTED



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Got them of us, at a price so low that he was astonished. YOU can do the same, and should send for our catalogue, which not only describes these instruments fully, but gives $ $ $ worth of instructions in their use. **It is free**

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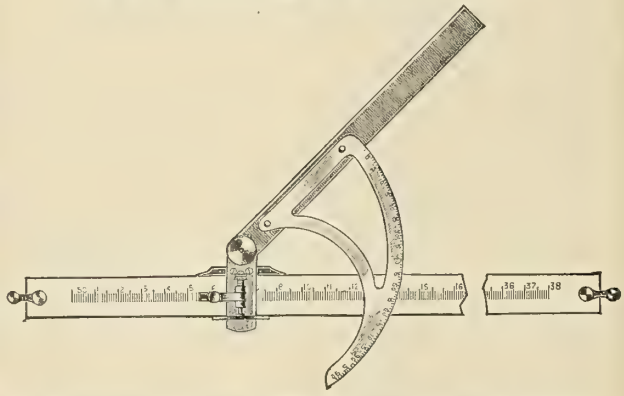
is once used, to use any other will be like returning to a bad habit.



In Material, Design, Workmanship, and Accuracy, this instrument is not excelled.
Made with bevel arm 15 to 36 inches; auxiliary blades carried in stock up to 36 inches.

Send for our FREE CATALOGUE No. 17L, which tells of all the STARRETT TOOLS.

The L. S. STARRETT CO., ATHOL, MASS.

The William Powell Company, 2525 Spring Grove avenue, Cincinnati, Ohio, will mail upon application from any inquirer a catalogue describing sight-feed lubricators, glass oilers, grease cups, and cylinder oil pumps.

The Crosby Steam Gauge and Valve Company Works, Boston, Mass., is mailing a folder illustrating and describing Crosby spring-seat valves. The folder claims as advantages for these valves strength, quality, and durability; disc seats and valve seats made of the best alloy, resisting any cutting from the flow of steam, all working parts renewable without removal of valve from piping, all parts interchangeable, a full opening through the valves, that they may be easily and quickly repacked, and the fact that all valves when completed are tested under more than 400 pounds hydraulic pressure. The company guarantees the valves not to leak.

Fred. Medart, 3530 to 3545 De Kalb street, St. Louis, Mo., has mailed a handsome illustrated catalogue describing power launches, sail, and row boats of every description, marine vapor motors, and complete boat equipments. Mr. Medart states that his favorable location in the Mississippi valley lumber region, together with the fact that he possesses one of the most completely equipped plants of the kind in existence, enables him to offer a superior line of supplies at the lowest possible price. It is stated that the gasoline engines sold at this plant are of a simple and compact design, and that they have fewer working parts than any other gasoline engines made. Vapor launches, row boats, combination row and sailing boats, sailing canoe materials, boat-building materials, launch hull frame materials, sailing yacht frames, and materials for a one-design "skip jack" are among the specialties Mr. Medart manufactures. The claim is made that by the Medart method of supplying boat-building material, the construction by amateurs of high-class boats is made possible, and at a very low price. Numerous testimonials to this effect are given.

IT IS WELL to mix DIXON'S PURE FLAKE GRAPHITE with your cup greases. It is still better to use DIXON'S GRAPHITED CUP GREASES because their formulae and proportions are the result of wide experience in the matter of the most efficient percentages for highest duty.

Made in seven degrees of hardness; the best greases procurable.

Write for Booklet 75-I.

JOSEPH DIXON CRUCIBLE CO.

Jersey City.

Circular No. 1059, issued by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., is devoted to automobile motive-power equipment and is profusely illustrated.

The Coburn Trolley Track Manufacturing Company, Holyoke, Mass., is mailing an illustrated pamphlet describing its overhead tram-rail traveling cranes, electric carriers, and appliances.

The Smooth-On Manufacturing Company, Communipaw avenue, Jersey City, N. J., has issued a booklet telling about Smooth-On, its different combinations and applications. The latest combination is Smooth-On with rubber, and it is found that this makes an excellent sheet packing, one that will withstand very high temperatures and pressures. Catalogue sent upon application.

Drop forgings are described in an illustrated catalogue issued by Wyman and Gordon, Worcester, Mass. The firm state that they make drop forgings of greater variety, heavier weight, and more complexity than any other concern in the country, their die forgings weighing up to more than 150 pounds each. The firm also illustrate and describe their drop-forged crank shafts, calling attention to the many special sizes and shapes they make, such as flanges on the ends, counterweights forged on, seats for counterweights, and multiple throw cranks set at any angle desired. They announce that they will continue to mail monthly to interested parties their "Short Stories," being little biographies of eminent American and European inventors and engineers.

The Great Lakes Engineering Works, Detroit, Mich., manufacturer of marine engines and steel ships, hydraulic dredging machinery, air compressors, marine boilers, and propeller wheels, is mailing a catalogue describing its products. Regarding the company's "semi-steel" propeller wheels, the catalogue states that "the use of semi-steel enables us to reduce thickness of blades and weight, and consequently to give increased efficiency; its use makes it no longer necessary to resort to the higher-priced bronze and steel wheels."

The Brown and Sharpe Manufacturing Company, Providence, R. I., is mailing a handsomely printed booklet illustrating and describing the many varieties of cutters the company makes. There are eighteen illustrations showing milling cutters of various kinds, side-milling cutters, interlocking side-milling cutters, end mills, spiral end mills, angular cutters, concave cutters, interlocking concave cutters, convex cutters, metal slitting saws, screw-slotting saws, taper reamers, gear cutters, and similar cutting machinery. Anyone desiring cutters of any kind should not fail to send for this booklet.

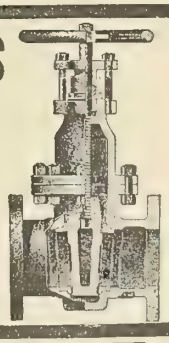
The Buffalo Forge Company, Buffalo, N. Y., has issued three very attractive booklets entitled "A Compound Engine Test," "Mechanical Induced Draft," and "Buffalo B." The first of these booklets describes and illustrates a test conducted at Sibley College, Cornell University, Ithaca, N. Y., of Buffalo Forge engine No. 1256. Tables are given showing results of the test which were extremely flattering to the maker. The second booklet describes and illustrates mechanical induced draft, and tells of many manufacturing plants where the Buffalo Forge Company's mechanical induced draft machinery is in operation. This booklet also describes automatic feed pumps, jet condensers, and automatic cut-off engines. The third booklet is devoted to "Buffalo B" volume blowers and exhausters.

The Philip Carey Manufacturing Company, Lockland, Ohio, is mailing a pamphlet describing the uses of its magnesia pipe coverings, and giving a long list of naval vessels, manufacturing plants, etc., where the covering is in use. The company states that its coverings have been used by the United States government since their introduction, and after being subjected to severe and extended tests. The company is also distributing an illustrated catalogue entitled "Carey's Coverings," which describes asbestos and magnesia steam pipe and boiler coverings, etc. The claim is made that these coverings are absolutely fireproof and thorough non-conductors of heat, that they confine the heat to the pipes and prevent loss through radiation, prevent the condensation of steam, obviate the necessity of excessive firing, and largely reduce the amount of fuel necessary; that they save enough fuel within six or eight months to more than repay their original cost, that they outlast the furnaces to which they are applied, and are in use and recommended by thousands of steam users throughout the country.

WATCH THIS SPACE FOR OUR NUMEROUS SPECIALTIES.

WALWORTH MFG CO
TOOLS and SUPPLIES for STEAM WATER and GAS USERS
BOSTON MASS

WALWORTH IRON BODY GATE VALVES



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With Renewable Bronze or Babbitt Seats.
Stationary or Rising Spindles.
Extra Heavy for 250 lbs. Steam.
Standard for 100 lbs. Steam.
Standard Babbitt Seat for 200 lbs. Water.

JOBBERS SELL THEM—IF YOURS DON'T, WRITE.
New York, Park Row Building. **WALWORTH MFG. CO.,** Boston, 128 Federal Street.
Write for our BLUE CATALOGUE "D." showing complete line of engineers' pipe fitting tools.

The White Craft and Power Company, Port Richmond, Staten Island, New York city, is mailing its monthly list of cruiser yachts, launches, house boats, and other craft for sale. It is stated that all motors are thoroughly overhauled and tested, and guaranteed to be in good working order before delivery.

The Lee Injector Manufacturing Company, Port Huron, Mich., is mailing a booklet illustrating and describing restarting injectors, ball check valves, globe and angle valves, purger attachments, ejectors, water gauges, strainers, etc. Much information is given regarding the size and care of injectors, temperatures, and steam losses.

A. D. Granger Company, 95 Liberty street, New York, N. Y., is mailing Bulletin No. 3 calling attention to the advantages of placing all contracts for the installation of a complete steam or electric plant with one responsible house. The company states that with its ten years' experience it is thoroughly competent to handle projects of any size with the best results.

The Rockwell Engineering Company, 26 Cortlandt street, New York, N. Y., has issued a folder illustrating and describing the new Rockwell rotary melting furnace for copper, brass, bronze, aluminum, etc. Oil or gas fuel may be used and there are no crucibles. A description of this furnace is published in our editorial columns.

Steel, Nacey and Hynd, marine architects, Western Reserve Building, Cleveland, Ohio, announce that they have taken over the business of Robert Logan, marine architect, Cleveland, and that they are prepared to furnish designs and specifications for all classes of lake vessels, to superintend construction, and to make appraisals and valuation.

The Acorn Engineering and Manufacturing Company, 27 Thames street, New York, N. Y., is mailing an illustrated folder describing the Acorn scale attachment. It is stated that a weight can be taken in one-fourth the time required by the usual method, and with absolute accuracy. The use of the attachment adds a perfect tare beam to the scales, as the tare can be instantly counterbalanced by moving the sliding poise. It is further claimed that the attachment adds 100 pounds to the capacity of the scales.

Rumsey and Company, Limited, Seneca Falls, New York, is mailing a circular describing hand pumps for steamboats, sailing vessels, wharves, factories, railroads, etc. Regarding the "Eagle" ship's main and bilge pump, it is stated that at a competitive test in New York city, this pump proved victorious over all others, two men filling a 650-gallon cask in nine minutes, raising the water to an elevation of 20 1-2 feet. Diaphragm and force pumps are among the specialties manufactured by the company.

Queen and Company, Incorporated, 1010 Chestnut street, Philadelphia, Pa., is mailing a pamphlet describing scientific instruments. The mathematical catalogue consists of 236 pages and will be mailed upon application. Drawing instruments, protractors, scales, precision, planimeter, slide rule, and other calculating instruments; triangles, wood, rubber, transparent celluloid, German silver, and steel; draftsmen's curves, rulers, and drawing boards are illustrated and described in this catalogue. The astronomical and meteorological departments are very complete.

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Model and Experimental Work
Plans and Specifications Prepared
Prompt Repair Work

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AT THE
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Madison Square Garden, New York
FEBRUARY 19—MARCH 5

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A limited amount of space still unsold. For further particulars, address

SPORTSMEN'S EXHIBITION CO.
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last longest if made of
"BENEDICT-NICKEL"
ELECTROLYSIS is positively resisted because "Benedict-Nickel" is an alloy of nickel and copper.
CORROSION is impossible, as the tubing is so perfectly homogeneous.
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BUILDERS OF SHIPS, Yachts, and Launches are often in need of Superintendents and other employees down the line, including engineers, draftsmen, foremen, machinists, patternmakers, foundrymen, fitters, etc.

ENGINE AND BOILER Builders frequently have similar vacancies which they are unable to fill satisfactorily or promptly.

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YACHT AND LAUNCH owners have great difficulty in securing masters, engineers, navigators, and other competent help.

To bring employee and employer together is the sole purpose of MARINE ENGINEERING EMPLOYMENT BUREAU.

First class men seeking employment will find this Bureau of great help in securing positions because of its confidential relations with employers.

Employers have, through this Bureau, the advantage of being brought into communication with men of experience and ability who would otherwise be unknown to them, and whose records have been investigated, and, at the same time, are saved the bother of being overwhelmed by applications for positions as soon as it becomes known that there is a vacancy.

For positions of responsibility the services of this Bureau are particularly valuable.

For full particulars address:

Marine Engineering Employment Bureau,

309 BROADWAY, NEW YORK.

CALENDARS RECEIVED.

The Morris Machine Works, Baldwinsville, N. Y., a calendar with a handsome lithograph of a sea-coast scene called "When the Flowing Tide Comes In."

Moran Towing Company, 10 South street, New York, N. Y., a calendar calling attention to its general towing business, and the fact that it fits tugs with fire and steam pumps and all necessary wrecking apparatus.

National Electric Company, Milwaukee, Wis., a calendar with a handsome reproduction in an oval setting of a painting of a young girl. The picture is called Cosette, and the calendar directs attention to electrical machinery and air brakes made by this company.

The American Steam Gauge and Valve Manufacturing Company, Jamaica Plain, Boston, Mass., a calendar illustrating its steam gauges, and calling attention to its valves, indicators, and governors.

Smooth-On Manufacturing Company, Jersey City, N. J., a calendar calling attention to its iron cements and sheet packings.

The Peters Cartridge Company, Cincinnati, Ohio, a calendar with a picture of a moose toiling through storm and snow past a hunter's cabin, with the motto "Protected."

The Cleveland Pneumatic Tool Company, Cleveland, Ohio, a calendar with a handsome lithograph of the head and bust of a young woman, artistically mounted on dark cardboard.

The Philip Carey Manufacturing Company, Lockland, Ohio, a calendar with a handsome oval picture in colors of a young girl leaning on a divan, the picture being easily detached and suitable for framing. The catalogue calls attention to the magnesia flexible cement roofing and magnesia pipe coverings manufactured by this company.

The Delaware Marine Supply Manufacturing Company, Wilmington, Del., a very attractive calendar in an oxidized bronze frame with a brass stand. Attention is called to the company's port lights, car trimmings, ship fittings, marine hardware, brass, bronze, and gun-metal castings, and other specialties.

Alfred B. Sands and Son, 134 Beekman street, New York, N. Y., a calendar with a well-known water color of a marine subject reproduced in the colors of the original drawing. Below is a calendar for 1904, and against each day is given the tidal calendar for Boston and New York, for the forenoon and afternoon, giving the hour of high water and low water, the height of the tide, and the time of sunrise and sunset. Also a table showing the widths of openings for vessels in all drawbridges in Boston, and the distances and bearings of prominent lights, buoys, etc., between New York and Mt. Desert, Me., magnetic courses, and distances. A copy will be sent upon application to all persons mentioning MARINE ENGINEERING.

THE ONLY WAY

To make a boat white and keep it white—the only way to paint a boat in tints and preserve the tints—the only way to make a boat beautiful and keep it beautiful, is to

Paint it with ZINC WHITE

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"Paints in Architecture,"
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THE NEW JERSEY ZINC CO.
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We do not grind zinc in oil. A list of manufacturers of zinc white paints will be furnished on request.

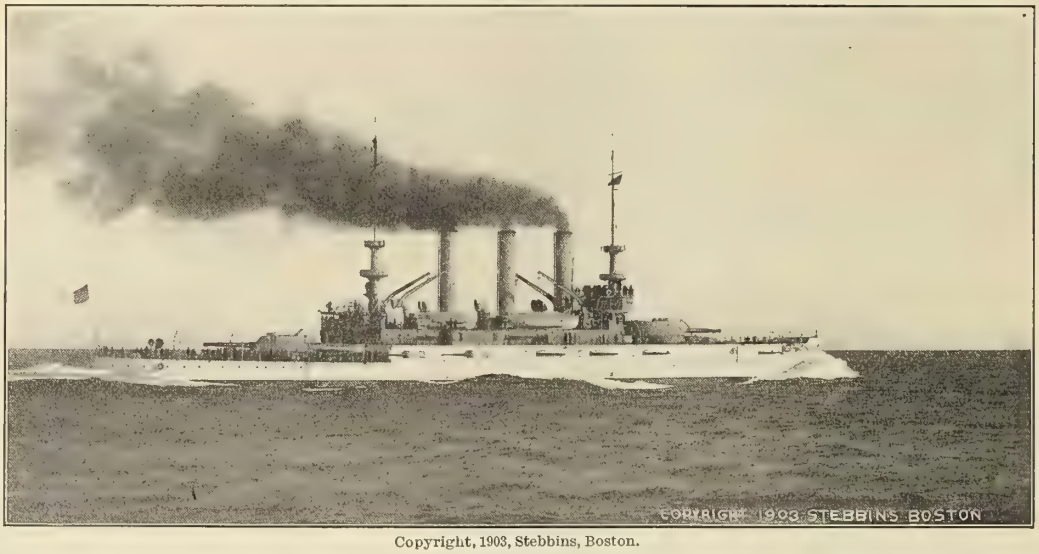
BUSINESS NOTES.

A material for preventing loss by fire and danger to life from the short-circuiting of high-voltage electrical wires, for which the trade-mark "Niagrite" has been adopted, is being placed on the market by the H. W. Johns-Manville Company. "Niagrite" is furnished in strips of several widths, from 3 inches to 36 inches, suitable for wrapping spirally on electrical cables, and is held in place with asbestos fire-proof glue, thus protecting the cables from external fire and confining any internal fire. The material presents a neat and permanent finish and is not affected by atmospheric conditions. It has been adopted by the Niagara Falls Power Company, the International Power Company, Buffalo Street Railroad Company, New York Edison Company, and other important electrical plants. Particulars may be obtained from the H. W. Johns-Manville Company, 100 William street, New York.

Wilson and Silsby, Rowe's Wharf, Boston, Mass., have made a suit of sales for the 125-foot water-line schooner-yacht *Intrepid,* owned by Lloyd Phoenix, New York. They also report the following list of orders already received for 1904: suits of sales: 10 suits for 17-footers, J. O. Johnson, White Bear, Minn.; *Chickadee,* F. E. Peabody, Boston, Mass.; 18-footer, George Lawley and Son, South Boston, Mass.; 30-footer, G. R. Liljegren, Gothenburg, Sweden; 35-footer *Umbrina,* W. H. Childs, New York, N. Y.; 80-footer *Chanticleer,* George W. Weld, Boston, Mass.; 18-footer, Charles F. Adams, 2d, Boston, Mass.; *Ada,* Fred. H. Seavey, Boston, Mass.; *Medric,* Herbert H. White, Cambridge, Mass.; ice boat *Jack Frost,* A. Rogers, Hyde-Park-on-Hudson, N. Y.; 21-footer, Rice Brothers, East Bootbay, Me.; *Uncle Sam,* J. Hopkinson Smith, New York, N. Y.; 18-footer, George C. Earle, Jr., Philadelphia, Pa. Mainsail for ice boat *Wizard,* R. D. Chandler, Fair Haven, N. J.

The Maxfield-Francke Company, 120 Liberty street, New York, N. Y., reports that it has made the following shipments of the Francke four-ported engine: Under-Feed Stoker Company of America, Chicago, Ill., first order 7 by 6 engine direct-connected to steel plate forced-draft blower; Struthers Wells Company, Warren, Pa., 7 by 6 engine for operating mechanical stoker; James Beggs and Company, New York, N. Y., 4 by 3 1-2 engine for operating mechanical stoker; Mershon Patent Shaking Grate Works, Philadelphia, Pa., 5 by 4 engine for operating disc ventilating fan; M. A. Hicks, Springfield, Vt., 4 by 3 1-2 engine for driving dynamo; Under-Feed Stoker Company of America, Chicago, Ill., second order, 5 by 4 engine, direct-connected to steel plate, forced-draft blower; Iowa Heat, Light, and Power Company, Des Moines, Iowa, 7 by 6 engine direct-connected to centrifugal pump; Linn Woolen Mills, Hartland, Me., 5 by 4 engine direct-connected to steel-plate blower; Lever Brothers' Soap Works, Cambridge, Mass., 7 by 6 engine for operating mechanical stoker; Robert Dobson Company, Pittsfield, Me., 7 by 6 engine direct-connected to steel-plate blower; McClave-Brooks Company, Scranton, Pa., 4 by 3 1-2 engine for operating mechanical stoker; George Bowen, South Charleston, N. H., 4 by 3 1-2 engine for driving dynamo; McMurtrie-Guiler Company, New York, N. Y., 5 by 4 engine direct-connected to centrifugal pump, for export to Porto Rico; Iowa Heat, Light, and Power Company, Des Moines, Iowa, second order, 5 by 4 engine direct-connected to centrifugal pump; Northern Engineering Company, New York, N. Y., 4 by 3 1-2 engine for driving dynamo; J. Heidingsfeld, New Brunswick, N. J., 5 by 4 engine for running printing plant. In addition to the above list, it has several makes of generators at the works for which engines are almost ready for direct-connecting, and which will be shipped to various points in the United States at an early date. Some of these engines are operating as low as 100 R.P.M., while others operate at all intermediate speeds up to as high as 800 R.P.M.

U. S. BATTLESHIP MISSOURI



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Simplicity.

Absolute control of fluids.

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All parts made to gauge of the best material.

Disks made of the celebrated "Powelium."

Will outlast 3 to 5 ordinary valves.

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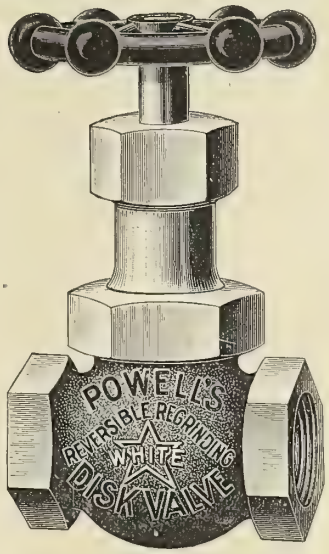

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Everything in the steam line for the boiler and engine room.

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THE STORY OF PHOEBE SNOW.

If you have ever taken a railroad trip you will enjoy the "Story of Phoebe Snow," which describes in a series of dainty pictures the experiences of a pretty girl who went to Buffalo. The illustrations are in seven colors, each reproducing a design of the girl in white which the Lackawanna Railroad has made so familiar in the last few months. The booklet has a particularly pleasing cover and will afford considerable amusement beside giving information which every traveler ought to know. It will be sent in response to request, accompanied by two cents in stamps, to T. W. Lee, General Passenger Agent, New York City.

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$2 (POST-PAID) **LUCAS'S** **$2** (POST-PAID)

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This unequalled work has been brought thoroughly up-to-date not only by careful revision of the retained text of former editions but by the addition of a great amount of valuable new matter.

THEO. AUDEL & CO., *Educational Book Publishers* 63 FIFTH AVENUE NEW YORK

INCREASED FACILITIES.—The Ollinger and Bruce Dry-Dock Company, Mobile, Ala., is now building a large floating dry-dock which will be 230 by 85 by 11 feet in size and will have a capacity of 3,000 tons.

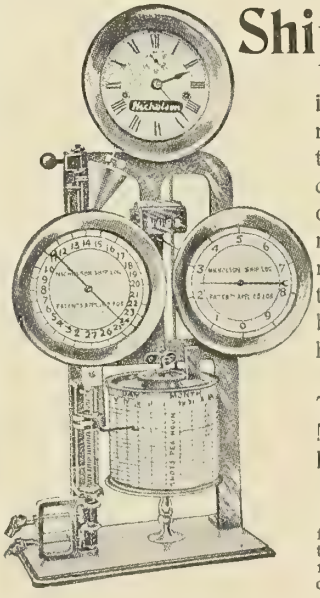
R. L. NEWMAN, naval architect, has removed his offices from 17 State street to 66-68 Broad street, New York, N. Y., and has formed a partnership with W. Merryweather, under the title of Newman and Merryweather, as naval architects, consulting engineers, and brokers, for the design and development of all classes of marine construction, surveying, and supervision of repairs.

THE B. F. STURTEVANT COMPANY, Hyde Park, Mass., is building a steam tunnel extending from the power plant of its new works to the most remote part of the manufacturing buildings, a distance of about 800 feet. This tunnel, which is of concrete construction, will not only accommodate all of the steam piping but also the electric wires for power, light, telephone, and other service, including oil, hot water, and other pipes.

MASON G. WORTH AND COMPANY, agents for John Brown and Company, Limited, makers of the Brown improved suspension furnaces, have removed their offices from the Witherspoon Building, to the Real Estate Trust Company Building, Philadelphia, Pa. It is claimed that the Brown furnaces are the only ones in the making of which the metal is not punished or distorted, and the only ones which are strengthened at the tops of the ribs.

W. K. MITCHELL AND COMPANY, Ellsworth street and Schuylkill river, Philadelphia, Pa., have recently removed their plant from Sixteenth and Washington avenue, Philadelphia, to the above location. The firm have issued an attractive illustrated pamphlet describing their new plant and their facilities for manufacturing flanges, fittings, valves of every description, iron, steel, copper, and brass pipe bends, recessed lap joints for steam, air, and hydraulic lines, steam separators, and high-pressure steam traps.

The Nicholson Perfected Ship Log



is the only log that accurately shows the speed of the moment of a ship, on a dial, and records this speed on a paper chart for every minute of the trip. It also registers the distance travelled. No line overboard. Placed in chart house or wherever desired.

THE NICHOLSON MARINE DISTANCE FINDER

Advantages Claimed:

The exact distance from any fixed point can readily be determined without any mathematical calculation. Anyone can easily learn to use it.

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ROBT. SNOWDON, 107 High St., Boro, London, S. E., England.

ARTHUR BEHRENS, Fontanka, 52, St. Petersburg, Russia.

The Racine Boat Manufacturing Company, located at Racine, Wis., for twenty-two years, has removed its main office and works to Muskegon, Mich., where the company has completed an extensive plant.

The Loomis-Pettibone Gas Machinery Company, 52 William street, New York, N. Y., has increased its capital stock, and has been merged with the Holthoff Machinery Company of Milwaukee, Wis., under the name of Power and Mining Machinery Company. The company manufactures the Crossley gas engine, of which it states that there are over 50,000 in operation.

Palmetto packing is quite generally being used by engineers throughout the country. It is a braided packing, made in sizes of 1-4 to 2 inches in diameter, and each strand is saturated separately before braiding in a special preparation of oil and then in graphite. This packing does not get hard, is made expressly for steam, air, and ammonia use. A free sample of this packing, suitable for small valve stems, will be mailed to any engineer on application to the manufacturers, Greene, Tweede and Company, 19 Murray street, New York, N. Y., by referring to Marine Engineering.

The Lunkenheimer Company, Cincinnati, Ohio, maker of superior brass and iron steam specialties, reports that owing to the unprecedented and growing demand for its specialties it has again greatly increased its facilities and is now in position to guarantee reasonably prompt shipments. It also reports, through its foreign branches, an increasing export demand for its specialties, and informs us that it will shortly place some new specialties upon the market, which will be contained in a very complete catalogue to be issued in the course of a few months.

Mr. John Livingstone, Montreal, Canada, recently addressing the New York Railway Club on the subject of staybolts, stated that the concentrated inflow of air through hollow bolts saves the ends at the inside of the fire box from burning, lessens the expansion of the bolt at the inner sheet, and the vibrating strains on the inside of the outer sheet. By not resisting the expansion of the sheet with counter expansion in the bolt, the danger of crystallization is lessened in the inside sheet of the fire box. This is not the case with solid or drilled bolts. Mr. Livingstone stated that for four or five years hollow staybolt iron had been subjected to tests which no ordinary or crystallized iron could endure.

The Lawrence Machine Company, Lawrence, Mass., has sold to the St. Joseph Water Works, St. Joseph, Mo., a 16-inch centrifugal pump having a capacity of 10,000,000 gallons of water per day. This pump will be directly connected to a Lawrence vertical cross-compound engine. This company has also closed the contract for a complete sewage pumping plant for the town of Hudson, Mass. The contract includes two Lawrence special shaft sewage pumps each having a capacity of 1,000 gallons per minute, together with a vertical shaft alternating-current electric motor, with the necessary transformers and devices for automatically starting and stopping the pumps and motors.

The France Packing Company, Tacony, Philadelphia, Pa., has secured the entire order to pack the piston rods of all engines in the rapid transit subway power house, New York, N. Y., with its "Steam Stopper" metallic packing. The company states that its plan to enable engineers to equip themselves with every tool they require, ranging from a monkey wrench up to a steam indicator, without sacrificing their own or their employers' interest, has proved an entire success judging from the numbers who are availing themselves of it. Some time ago the company placed on the market a new high-pressure packing ring, made of the finest long-fibre asbestos yarn, and spun with a metallic wire. It met with such success at the beginning that a number of railroads have adopted it exclusively for use on their locomotive air pumps. The 1904 catalogue, which will be one of the most complete in its line, is ready, and may be had for the asking by readers of this magazine.

"Throw Away Your Glue Pot"

WHY have the smell of boiling glue around you all day, and the waste and expense of boiling dry glue, when you can for less money use

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" 89, L. O. Willix, 89 Elizabeth St., Ogdensburg, N. Y.
" 91, R. Davidson, 17 Fairfield Ave., Har. Sta., Ashtabula, O.
" 92, H. E. McArthur, 16 Abstract Bldg., Saginaw, Mich.
" 93, M. E. Davis, 929 D St., N. W., Washington, D. C.
" 94, George R. Jones, Box 222, Washington, N. C.
" 95, P. J. McMahon, P. O. Box 199, Key West, Fla.
" 100, Thos. F. Sullivan, Honolulu, H. I.
" 101, J. K. Cotton, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., So. Haven, Mich.
" 103, A. E. Pittman, P. O. Box 378, Newbern, N. C.

TRADE PUBLICATIONS.

The Carlisle and Finch Company, 229 East Clifton avenue, Cincinnati, Ohio, is distributing a handsome calendar calling attention to search light projectors, for use on yachts, launches and steamships.

James H. Tarr, Gloucester, Mass., is mailing a calendar with a handsome marine picture representing two full-rigged ships in imminent danger of collision, and entitled "A Close Call." The catalogue states that Mr. Tarr is a manufacturer of copper paint, marine iron paint, etc.

The Crandall Packing Company, Palmyra, N. Y., is mailing an illustrated catalogue of steam, ammonia and hydraulic packings. The company manufactures a large line of packings for all purposes, among which may be mentioned special marine packing, ammonia ring packing, ammonia spiral packing, expansion ring packing, made for both hot and cold water, expansion ring steam packing, both flat and spiral, high pressure packing in coils and rings, hydraulic coil and ring packing, red core piston packing, sectional ring packing for hot and cold water and steam, asbestos sheet packing, steam hammer packing, and throttle valve packing. In addition the company manufactures many other engineering specialties, such as asbestos rope, asbestos rubber tape, gaskets of many varieties, hose, and rubber belting. The advantages claimed for the Crandall packings are that they are made from special material selected under the company's supervision, that they are lubricated by its patent cold oil process, that they are thoroughly tested to stand the extreme heat and pressure of stuffing boxes, and that they will not harden, blow out, melt or gum the rod.

The Lackawanna Motor Company, 51-61 Letchworth street, Buffalo, N. Y., is sending out a catalogue illustrating and describing marine motors, automobile motors, reversing devices, clutches, and transmissions. The Lackawanna motors operate on the two-cycle principle. Numerous impulses, one in each cylinder every revolution of the shaft, give great flexibility of speed, 250 to 2,000 R. P. M. being produced. It is stated that the Lackawanna motors develop more power for their weight than any motors on the market, and that the absence of springs, gears, cams, levers, valves and push rods makes them simple, reliable and long-lived. The jump spark system of ignition is employed, which it is said is very economical with the electric supply. The bearings are of ample dimensions, are lined with a special bearing metal and are reamed to size. Crank shafts are of forged steel, the connecting rods being of bronze. The catalogue states that the marine motors develop their rated horsepower at 500 R. P. M., but are capable of running at higher or lower speed as required. The marine outfit includes motor with base for placing in boat (or brackets if preferred), carburettor, circuit breaker, spark plugs, grease cups on main bearings, muffler, starting crank, pump, cylinder oiler, ball bearing thrust, and couplings bored to suit shaft as ordered. It is claimed that the reversing device used in connection with the marine motors obviates the necessity of reversible blade propeller, or reversing gear. The motor is wired in the usual manner as to batteries, spark coil, etc., with a ground wire running to a handle which operates on a notched segment and shifts the spark. On each end of this segment is a fibre insulating piece so that when the handle is at either end the circuit is broken. On the flywheel is a governor composed of a spring and contact point which rests on a metal ring insulated from the shaft when motor is at rest. As the speed increases this contact point is thrown away from the ring by centrifugal force. By this governor a ground is produced as the motor slows down, and by throwing the handle over in the opposite direction the motor is reversed by premature ignition, in other words giving a spark before the piston is up.

When writing to advertisers please refer to MARINE ENGINEERING.

The France Packing Company, Tacony, Philadelphia, Pa., has issued an illustrated catalogue describing metallic and fibrous packing. The company makes high pressure marine packings, ammonia packings, spiral piston and valve rod packing, gum core packing, square braided flax packing, water proof hydraulic packing, asbestos metal packing, asbesto-metallic sheet packing, gaskets, and other engineering specialties. The piston rods of the New York subway engines are equipped with France metallic packings.

The Lozier Motor Company, 1 Broadway, New York, N. Y., states in the February issue of *The Propeller,* which it publishes, that it has been engaged in the business of manufacturing steel products of automatic machinery for eighteen years, and that its engine plant at Plattsburg, N. Y., is the largest and best equipped plant in the world devoted to the manufacture of marine gasoline engines. In New York City the company has boat works where boats of special design are built in any size from sixteen to ninety feet in length. Regarding the successful building of marine gasoline engines, the company states that one of the first essentials is a perfect casting. Every Lozier casting is made in the company's own foundry by men who thoroughly understand the particular requirements of castings designed for marine work. Among the advantages claimed for the Lozier engines are absence of noise, coolness of the engine, automatic oiling, absence of odor, absence of vibration, reliability and speed control. Copies of *The Propeller* will be sent free to any readers of Marine Engineering.

The Buffalo Gasoline Motor Company, 1280 Niagara street, Buffalo, N. Y., is issuing an exceptionally handsome catalogue illustrating and describing marine gasoline motors. The company states that its motors contain solid one-piece steel forged crank shafts, and mechanically operated inlet valves, thus assuring a regular supply with a steady measured impulse, and producing regular speed and reliability. All motors are equipped with metal enclosed bases with detachable panels, so that access to all parts is easy. Solid steel forged valves are used and there are five heavy bearings in the base of the motor, assuring firm joints for crank shaft. Motors are completely water-jacketed, including head and valves. There is no packing except on the water jacket plate. All four cylinders are fed with a carburettor through one inlet casing. Special attention is given to making pistons and pistons rings fit. These, after being turned, are split, turned and ground to proper size, thus assuring perfect compression and a true circle. Motors are equipped with the make and break, or the jump spark, as the purchaser prefers.

The Picher Lead Company, Tacoma Building, Chicago, Ill., is mailing an illustrated pamphlet called "The Story of Picher Sublimed White Lead." The pamphlet opens with an "Inventor's Prologue," by E. O. Bartlett, the general manager of the company, telling how the idea of subliming white lead with fire and catching it in bags occurred to Mr. Bartlett. It is said that the idea that white lead could be produced direct from the ores without tan bark, manure, acetic acid, or any of the familiar methods, was received with incredulity, but that all problems were finally solved and the project carried to success. The sulphide ore of lead (galena) is heated to the sublimation point and the heated vapors, taking up oxygen from the air, are transformed from the sulphide to the oxy-sulphide of lead. It is stated that "the durability of paint is in direct ratio to the percentage of oil it absorbs and carries to the painted surface, and to the chemical stability of the pigment contained." It is claimed that Picher sublimed white lead is an absolutely stable compound of lead, which without any chemical reaction absorbs very large proportions of oil. Full details are given of the process of manufacture, and the results of tests and comparisons with other paints. The pamphlet will be mailed upon application.

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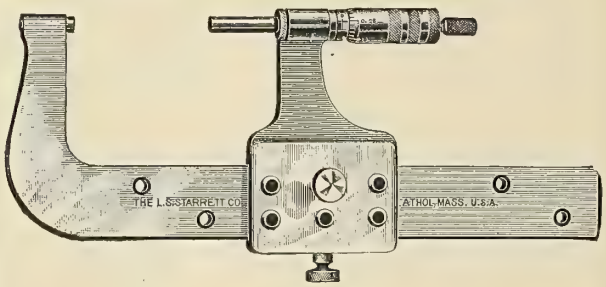
Six Inch Micrometer

will measure round work to 4½ inches and flat work to 6 inches. It weighs 21 ounces and is rigid and accurate.



IT is sold in a neat leatherette case, and is a most desirable instrument for every engineer and machinist to have. . . .

Send for our FREE CATALOGUE No. 17L, which tells of all the STARRETT TOOLS.

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ATHOL, MASS.

A NEW THROTTLE VALVE

Powell's "Titan" and "Giant"

FOR LAUNCHES, STEAM CARRIAGES, AUTOS, ROAD ENGINES, ETC., ETC.

NO FRICTION

By means of improved construction the valves can be opened or closed with ease under the highest pressure.

SIMPLE—DURABLE

ALL PARTS MADE TO GAUGE

The "Titan" for 175 pounds pressure.

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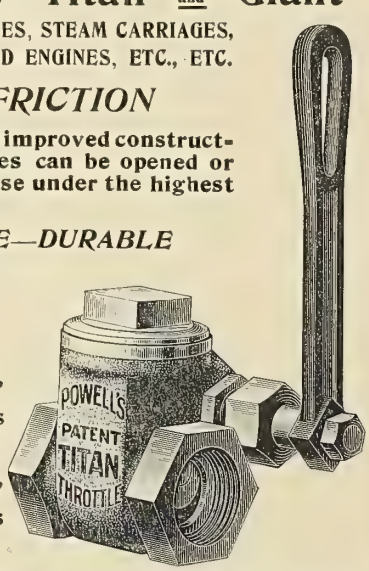

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Everything in the steam line for the boiler and engine room.

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THERE is no "dead reckoning" in the matter of **Dixon's Graphite Cup Greases.**

You are getting the best friction-reducing combination that science and skill can produce and following the straight course for keeping bearings and pins cool.

Booklet 75-I describes our greases. Samples upon request.

JOSEPH DIXON CRUCIBLE CO.
Jersey City, N. J.

The Nicholson File Company, Providence, R. I., will send free upon application a booklet entitled "File Filosophy," which contains much information of value to users of files and rasps.

The New York Central and Hudson River Railroad Company, New York, N. Y., is mailing an attractive illustrated folder calling attention to the advantages of using its line to the coming World's Fair at St. Louis. A ground plan of the fair grounds is given, together with illustrations of the buildings, and a railroad map showing the route of the New York Central and its various connections. No one contemplating a trip to the World's Fair should fail to write for this folder.

Alexander Hynd, Western Reserve Building, Cleveland, Ohio, is mailing a folder describing Sturrock patent smoke consuming furnace bridge walls, for marine and stationery engines. It is stated that the Sturrock wall is in use on the foremost steamship lines of the United States and Great Britain. Among the special advantages claimed are: facility of removing and replacing bridge walls for inspection and when laying up; that they can be removed without destroying any part of the bridge, and replaced without requiring renewals; facility in cleaning fires, as no clinkers adhere to the bridge wall; better combustion of fuel and large reduction in the emission of black smoke, with resulting economy; that they will not twist or warp and will last for years.

The Monash-Younker Company, 43 Centre street, New York, N. Y., is distributing a folder describing automatic air valves.

The Universal Safety Tread Company, 45 Broadway, New York, N. Y., is mailing an attractively printed calendar calling attention to its safety treads for stairways, yachts, steamboats, elavator landings, etc.

The Veeder Manufacturing Company, Hartford, Conn., is mailing a booklet describing revolution counters. The company states that its counters are suitable for any purpose requiring a small, light and accurate instrument.

The Rudder Publishing Company, 9 Murray St., New York, N. Y., is mailing a catalogue of books and nautotypes for a yachtman's library. The ON and HOW-TO series of books are of interest to yachtsmen and amateur boatbuilders of all classes.

The Standard Tool Company, Cleveland, Ohio, is mailing a calendar calling attention to its twist drills, milling cutters, reamers and taps. The company also makes sockets, emery wheel dressers, drill chucks and other tool specialties.

The H. W. Johns-Manville Company, 100 William street, New York, N. Y., is distributing samples of asbestos used in making curtains for theatres and for other purposes. No. 6193 is interwoven with brass wire. This cloth is fire-proof and will not crack when water is turned on while very hot.

E. Stutz, 54 Front street, New York, N. Y., announces that he is now in a position to supply thermit from stock in New York, and will, upon application, mail pamphlets giving instructions for the use of the material, so that any intelligent mechanic can be made acquainted with the thermit process of welding cast iron or steel.

The Binsse Machine Company, Newark, N. J., is mailing its illustrated catalogue No. 3 describing horizontal boring machines. It is stated that for drilling and boring demanding accuracy the horizontal machine excels. The work table has three movements, one in the verticle and two in the horizontal plane. When the work is set vertically, the table is moved crosswise and lengthwise until the horizontal setting is found. No blocking is required. The boring bar slides within the main spindle and revolving with it can be handled with ease. It can be used with an attached boring head for holes larger than its own diameter, while for drilling smaller holes stub bars are employed with inserted cutters or boring heads, or special cutting tools of any description, all of which are held in the end of the large bar. The bar has three varieties of feed; it can be advanced a fraction of an inch to try the cut, or it can be drawn back to measure the bore at the rate of a foot for each turn of the hand wheel. The power-feeds cover all requirements from drilling to broad cut finishing. This company also manufactures leveling jacks which it is said are indispensable in every shop producing scraped surfaces.

WALWORTH MFG. CO.
TOOLS and SUPPLIES for STEAM WATER and GAS USERS
BOSTON MASS.

Walworth Mfg. Co., 130-136 Federal St. BOSTON
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Specialty of **BRASS VALVES** and Fittings for Marine Construction

Extra Heavy Valves, Bent Pipe and Fittings for High Pressure Work

SOLE MANUFACTURERS OF
WALWORTH FLANGED—OVER PIPE JOINT
Which does not Weep under heavy pressure

OUR BOOK CONTAINING "TABLES OF DIMENSIONS" OF WALWORTH GATE VALVES, FLANGED FITTINGS, FLANGED OVER PIPE JOINTS, WROUGHT IRON BENDS, ETC., should be in your draughting room.

The Bullock Electric Manufacturing Company, Cincinnati, Ohio, chooses Thomas A. Edison for the subject of the sketch on the back of its February card calendar. A brief resumé of his life and inventions is given, together with a portrait. The calendar is handsomely designed in several colors, and is suitable for desk use.

The Delaware Marine Supply Manufacturing Company, Wilmington, Del., is mailing a card catalogue calling attention to its various marine specialties. There are fifteen cards attractively printed and fastened together, and describing port lights of various kinds, deck lights, deck scuttles, ventilators, door handles, butts, rail sockets, hinges, and pulleys. There are numerous illustrations.

The Philip Carey Manufacturing Company, Lockland, Ohio, is mailing an abstract of a paper entitled Steam Pipe Covering and its Relation to Station Economy, which was read before the twenty-third convention of the Association of Edison Illuminating Companies. The paper gives the results of a test made before awarding the contract for covering the steam pipes in the Manhattan Railway Company's power house in New York. Diagrams and tables are given, showing the relation between thickness of steam pipe covering and total expense for various lengths of life, etc. As a result of the test, Carey's 85 per cent. carbonate of magnesia covering was adopted.

The Crocker-Wheeler Company, Ampere, N. J., is mailing its bulletin No. 40, entitled Crane Motors. Descriptions and illustrations are given of crane motors of various sizes and designs. It is stated that the manipulation of traveling cranes is a service to which electric motors are particularly well adapted. The power is easily transmitted any distance and with little loss, the motors require a small amount of space, they can be readily attached to the various parts of the crane, and can be instantly and conveniently controlled by the operator. The use of separate motors for the various movements of the crane affords a means of performing these movements rapidly and simultaneously, thus saving much time.

Panhard & Levassor, whose American branch is at 230 West 13th street, New York, N. Y., are mailing a catalogue giving diagrams showing the sectional elevation and accommodation plan of a 31-foot auto-boat equipped with one of their 15 H. P. four-cylinder motors. The hull of the boat was built by the Electric Launch Company, Bayonne, N. J., and was on exhibition at the Sportsmen's Show, in New York, last month. The frame is of light oak. The double planking is of elm and mahogany. The outside planking, decks and interior are handsomely finished in natural mahogany. The automobile type of seat is provided, giving a capacity for seven. The metal work of the hull is of brass and copper. Total weight of boat with engines, 1,150 pounds. Automobiles are also illustrated and described in this catalogue.

The second edition of Catalogue No. 115, the general condensed catalogue of the B. F. Sturtevant Co., Boston, Mass., is now ready for distribution. This catalogue describes and illustrates a number of new apparatus manufactured by this company, among which are: a new type of hand-blower; several new types and sizes of forges; new sizes of vertical single and double engines; a new type of enclosed vertical compound engines; new type of semi-enclosed bipolar and 4-pole motors; new sizes of generating sets with vertical compound engines; factory equipments, such as bench-legs, pattern storage shelf brackets, electric hoists, cast iron sinks, trench coverplates, etc.; industrial railway equipments such as cars, a description of the various Sturtevant systems, such as heating and ventilating, special ventilating, drying, conveying and mechanical draft systems.

BROWN OR BLACK

May be desirable colors; but when one selects white or a tint, he does not want brown or black.

ZINC WHITE

Is the only white pigment that holds its color in marine work—therefore ZINC WHITE is the only available pigment for white or tints on ships or boats.

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We do not grind zinc in oil. List of manufacturers of zinc white paints will be furnished on request.

CONDENSER TUBES

last longest if made of

"BENEDICT-NICKEL"

ELECTROLYSIS is positively resisted because "Benedict-Nickel" is an alloy of nickel and copper.

CORROSION is impossible, as the tubing is so perfectly homogeneous.

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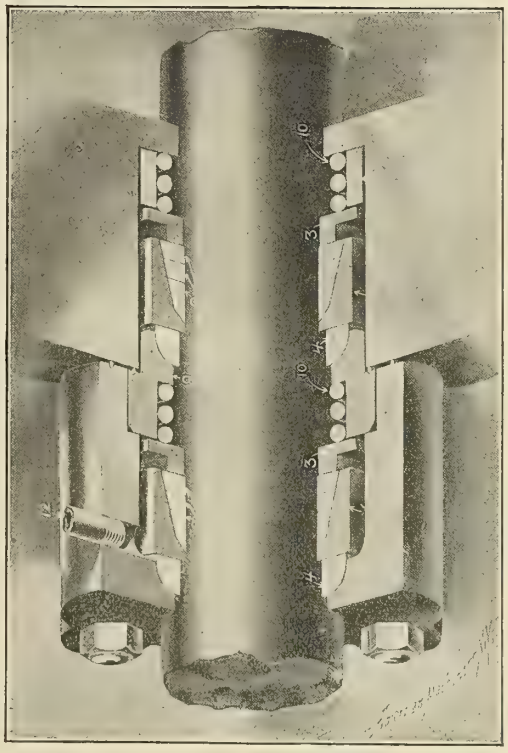
New York, 253 Broadway Boston, 172 High St.

The Marine Iron Works, Chicago, Ill., is distributing catalogue No. 16. This catalogue illustrates and describes triple expansion marine engines, compound marine engines, solid back type, heavy service marine engines with single cylinders, double cylinder marine engines, open column frame marine engines and machinery, condensing apparatus, paddle wheel machinery, water back marine boilers, propeller wheels, pumps, capstans, steering wheels, search lights, etc. The company builds all of its own marine boilers. Diagrams and illustrations are given of Scotch marine boilers, horizontal fire-box marine boilers, Clyde marine boilers, submerged tube vertical marine boilers, and of safety water tube boilers. The company makes a specialty of paddle wheel machinery, and machinery of all kinds for river and lake boats. A special pamphlet on river navigation is issued, which will be sent on application to those interested.

The American Steam Pump Company, Battle Creek, Mich., is mailing an illustrated catalogue describing Marsh boiler feed pumps, yacht pumps, plunger pumps, and other pumps. The Marsh live steam actuating and governing valve and other valves are also described.

Wyman & Gordon, Worcester, Mass., manufacturers of drop forgings, in the last issue of their brief monthly biographies, tell of the life and inventions of Richard Arkwright. The company has already published biographies of the following engineers, which, with the exception of a few that are out of print, will be sent free upon application: James Watt, Matthew Boulton, Robert Fulton, George Stephenson, James Nasmyth, Sir Henry Bessemer, Sir William Siemens, Alfred Krupp, Elias Howe, John Ericsson, Sir Joseph Whitworth, Benjamin Franklin, John Fitch, Oliver Evans, John Stevens, Eli Whitney, Thomas Blanchard, Peter Cooper, Alexander L. Holley, William R. Jones, James B. Eads.

United States Metallic Packing



Class No. 1 Packing

¶ While it is in fact a *Double Packing* with two sets of rings on the rod—(one in reserve should the other fail)—still *friction* is reduced to a minimum and hot rods are unknown where it is used.

¶ Renewals cost comparatively little—are easily made and last a long time.

* * *

Catalog and Price List on Application.

The United States Metallic Packing Company

Main Office and Works: 427 No. Thirteenth St., Philadelphia, Penna.

Chicago, 509 Great Northern Building

Seattle, MORAN BROS. San Francisco, W. H. PIERSON

Warren Webster & Company, Camden, N. J., are mailing a card calling attention to Webster feed-water heaters and purifiers. It is stated that 1,250,000 H. P. are in use.

Mason G. Worth & Company, Real Estate Trust Building, Philadelphia, Pa., are sending out a leaflet calling attention to wire rope for hoisting, rigging, hawsers, switching; and to crucible, plough or open hearth steel, plain or galvanized.

The C. O. Bartlett & Snow Company, Cleveland, Ohio, is mailing a catalogue illustrating and describing interlocking shoulder bearing chain belts. General catalogue No. 7, illustrating and describing detachable chain belts, elevators, conveyors, steam and direct heat dryers, gears, and other machinery, will be sent upon application.

Graphite, published by the Joseph Dixon Crucible Company, Jersey City, N. J., calls attention in the February issue to Dixon's graphite pipe-joint compound. There is also an article telling of an engineer's first experience with graphite, describing how, with the aid of this substance, he was enabled to keep the machinery running without waiting for a hot box to cool.

The Wm. Powell Company, Cincinnati, Ohio, is distributing folders describing its engine and boiler room specialties, such as "Trojan" sight up-feed lubricators, cylinder oil pumps, glass engine oilers, and a new form of throttle valve. By a radical departure in the construction of the operating parts, the throttle valves are claimed to open and close without the slightest friction under the highest pressure.

The Leeds Marine Equipment Company, Bridgeport, Conn., Atlantic coast general agents for the Hercules Gas Engine Works, San Francisco, Cal., is mailing a folder describing the Hercules engines—marine, stationary, portable, and for hoisting purposes. It is stated that the Hercules Gas Engine Works are among the largest and best equipped in the United States, and that more than 6,000 of their engines are in operation. Duplicate parts are kept in stock at Bridgeport, and repairs can be made there. The Leeds Marine Equipment Company builds, repairs and stores yachts and working boats.

Thos. H. Dallett Company, York street and Sedgley avenue, Philadelphia, Pa., is distributing its illustrated catalogue describing pneumatic tools. Of the Dallett hammers it is stated that they are simple in construction, the piston and valve being the only moving parts; that the movement of the valve is lengthwise with the cylinder and in the same direction as the movement of the piston, thus eliminating the tendency of its being jarred off the seat by the impact of the hammer blow, and enabling the hammer to attain a very high rate of speed. A page is devoted to directions for the care of hammers.

The H. W. Johns-Manville Company, 100 William street, New York, N. Y., is distributing a folder calling attention to its asbestos roofing, and showing the following report of a government expert: Washington, D. C., July 29, 1903.—"The report of the supervising architect is to the effect that the sample of asbestos roofing offered by the H. W. Johns-Manville Company is distinctly superior to the others for the purpose under consideration, even if offered at a price somewhat in excess of the latter, and that the relative order of merit of the remaining samples is not sufficiently pronounced to justify any serious discrimination except in price."

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Model and Experimental Work
Plans and Specifications Prepared
Prompt Repair Work

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BUILDERS OF SHIPS, Yachts, and Launches are often in need of Superintendents and other employees down the line, including engineers, draftsmen, foremen, machinists, patternmakers, foundrymen, fitters, etc.

ENGINE AND BOILER Builders frequently have similar vacancies which they are unable to fill satisfactorily or promptly.

SHIP AGENTS AND OWNERS may want licensed masters or pilots, engineers or assistants, or other help for shore or sea duty.

YACHT AND LAUNCH owners have great difficulty in securing masters, engineers, navigators, and other competent help.

To bring employee and employer together is the sole purpose of Marine Engineering Employment Bureau.

First class men seeking employment will find this Bureau of great help in securing positions because of its confidential relations with employers.

Employers have, through this Bureau, the advantage of being brought into communication with men of experience and ability who would otherwise be unknown to them, and whose records have been investigated, and, at the same time, are saved the bother of being overwhelmed by applications for positions as soon as it becomes known that there is a vacancy.

For positions of responsibility the services of this Bureau are particularly valuable.

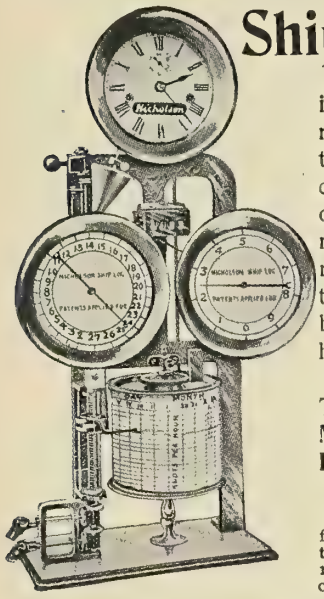
For full particulars address:

Marine Engineering Employment Bureau,
309 BROADWAY, NEW YORK.

THE STORY OF PHOEBE SNOW.

If you have ever taken a railroad trip you will enjoy the "Story of Phoebe Snow," which describes in a series of dainty pictures the experiences of a pretty girl who went to Buffalo. The illustrations are in seven colors, each reproducing a design of the girl in white which the Lackawanna Railroad has made so familiar in the last few months. The booklet has a particularly pleasing cover and will afford considerable amusement beside giving information which every traveler ought to know. It will be sent in response to request, accompanied by two cents in stamps, to T. W. Lee, General Passenger Agent, New York City.

The Nicholson Perfected Ship Log



is the only log that accurately shows the speed of the moment of a ship, on a dial, and records this speed on a paper chart for every minute of the trip. It also registers the distance travelled. No line overboard. Placed in chart house or wherever desired.

THE NICHOLSON MARINE DISTANCE FINDER

Advantages Claimed:

The exact distance from any fixed point can readily be determined without any mathematical calculation. Anyone can easily learn to use it.

NICHOLSON SHIP LOG CO.

204 Superior Street, Cleveland, Ohio, U. S. A.

W. H. PIERSON, 421 Market St., San Francisco.
ROBT. SNOWDON, 107 High St., Boro, London, S. E., England.
ARTHUR BEHRENS, Fontanka, 52, St. Petersburg, Russia.

United Harbor No. 1, American Association of Masters and Pilots of steam vessels, Battery Park Building, New York, N. Y., has issued its official souvenir book and log. A brief history of the origin of the association and what it has accomplished is given.

The Joseph Dixon Crucible Company, Jersey City, N. J., is mailing a card calling attention to its silica-graphite paint, stating that it was the first graphite paint made, and claiming it to be the best preservative for steel and iron construction.

The Crosby Steam Gage and Valve Company, Boston, Mass., is sending out a folder describing pop safety valves. The company states that its safety valves are automatic, certain in action, prompt in opening and closing at the required pressure, and that they relieve the boiler rapidly with the smallest possible loss of steam.

REVISED AND ENLARGED EDITION

$2 (POST-PAID) **AUDEL'S** **$2** (POST-PAID)

QUESTIONS AND ANSWERS

By Lucas and Hawkins.

The Standard Hand-Book for the Marine Engineer in all times and in all climes.

684 Pages Several Plates 224 Diagrams
Handsomely bound in green silk, with full gold edges

This unequalled work has been brought thoroughly up-to-date not only by careful revision of the retained text of former editions but by the addition of a great amount of valuable new matter.

SEND FOR MARINE ENGINEERS' CATALOGUE.

THEO. AUDEL & CO., *Educational Book Publishers* 63 FIFTH AVENUE NEW YORK

BUSINESS NOTES.

THE MARINE IRON WORKS, Chicago, Ill.—A contributor writes as follows, with an appreciation of the facts set forth for prospective buyers of marine machinery: "There is a feature in connection with this marine engine business in the small and medium-size work (20 to 500 H. P.) that you will understand, viz.: If a concern which for a number of years has devoted its attention exclusively to the work, taking a real interest in it, and keeping the more or less old patterns as nearly modern as such a procedure would permit, is totally wiped out by fire and all of the patterns destroyed, you can realize that an ideal opportunity is offered for either quitting entirely or starting fresh. If the latter plan is adopted, it presents the advantage of incorporating into new patterns all that was best in the old, together with many good features which the old designs would not permit." It was this latter plan that the Marine Iron Works of Chicago selected and has been following for the past two years, and although it has been "hard sledding" at times and at first was a tremendous loss, it is proving a positive benefit. "To-day the company's line of engine patterns," he writes, "especially in compounds and triple expansions, is at least 100 per cent. better and more complete than those that went up in smoke two years ago. If these facts were known to a larger proportion of the intelligent buyers of such machinery, it would be of value to all parties concerned, not excepting the users. Every one familiar with marine machinery, within the range of work referred to, knows that no concern in the country can very well afford to deliberately destroy all patterns, and it requires some real calamity to compel it to make an entirely new and complete line. It might seem possible for a newly organized company to do this, but it could not have had that associated experience so necessary in discussing and deciding upon seemingly minor but really important details of construction."

THE AMERICAN AND RED STAR LINES are distributing a circular regarding service for the coming season, from which the following is taken: The sailing day of the American Line steamships from New York has been changed from Wednesday at 10 A.M. to Saturday at 9:30 A.M. Eastbound the steamers will call at Plymouth (England) and Cherbourg (France) to land passengers and mails, and will then proceed to Southampton. Passengers will have the option of disembarking at any one of the three ports, where special trains will be awaiting to convey them to London or Paris. This improved service will be maintained by the four large twin-screw express steamships *St. Louis, St. Paul, New York* and *Philadelphia.* These steamships have recently undergone an unusually thorough rehabilitation, and in every department they are in the highest degree of perfection. The Red Star line for over 33 years has been synonymous with regularity and punctuality. The steamers of this line have carried over a million passengers without a serious accident. This record has kept this company in the front rank of popularity with ocean travelers. The steamers sail from New York on Saturdays at the fixed hour of 10:30 A.M. and from Antwerp also on Saturdays, but at hours governed by the state of the tide. The present fleet is composed of the large new twin-screw steamships *Finland, Kroonland, Vaderland* and *Zeeland,* each of 12,760 tons. These vessels, while not "ocean greyhounds" in the strict sense of the word, are of the best type of modern passenger ships. Except in the one point of speed, they are the equal of the finest ships afloat and will enable persons to enjoy at moderate expense all the luxuries of the fastest transatlantic flyers. All the steamers of both lines are fitted with the Marconi system of wireless telegraphy, a convenience which is appealing more and more to the transatlantic traveler. Special arrangements have been made to furnish by wireless telegraph from Nantucket and Poldhu the latest news, which appears in the newspaper published on board.

The Edson Manufacturing Company, 255 Atlantic avenue, Boston, Mass., reports that it has applied many new ideas in the manufacture of its steering gears, diaphragm pumps, etc. The pony Meteor racing gear for 25 or 30-foot yachts is said to be in great demand among yachtsmen. The company makes marine appliances of all varieties.

Sheriff's Manufacturing Company, Milwaukee, Wis., reports an especially prosperous season, with a greatly increased demand for propeller wheels. The company states that up to date it has turned out 2,340 propeller wheels, ranging in size from 12 inches in diameter up to 13 feet. Most of the wheels are made of cast iron, but wheels up to 8 feet in diameter are made of cast steel.

American Steam Gauge and Valve Company.—Mr. P. H. Wilhelm, formerly representing the New York Car Coupler Company, the Washburn Car Coupler Company, the Buckeye Malleable Iron and Coupler Company, the Railroad Supply Company of Chicago, with headquarters at Atlanta, Ga., has accepted a position as railroad representative of the American Steam Gauge and Valve Manufacturing Company, Boston, Mass., with branch offices at New York, Chicago, Philadelphia and Atlanta, Ga. Mr. Wilhelm has spent the greater portion of his life in the actual railroad service and it will be remembered that, in 1893, he was, on the recommendation of the majority of the railroads, appointed division superintendent of transportation at the World's Fair in Chicago. After the close of that exposition, he took up the active business of railroad supplies, which he has followed up to the present time. Mr. Wilhelm has been very prominently mentioned for the position of superintendent of transportation at the St. Louis Exposition, but he prefers to remain in the active railroad supply business. The American Steam Gauge and Valve Manufacturing Company is believed to have the largest plant in the country devoted to the manufacture of steam and other gauges, safety valves, steam engine indicators, whistles and steam supplies in general, and being one of the oldest houses in this country in this particular line, Mr. Wilhelm will be able to keep up his reputation of representing one of the best houses in the country.

The Buffalo Feed-Water Regulator.—Mr. Robert Learmonth, 100 White street, Buffalo, N. Y., has patented a feed-water regulating device. The inventor has employed for its actuating power the expanding and contracting of a copper tube by being heated and cooled. The operation of heating and cooling is derived from the steam and water in the boiler in which it is desired to maintain a regular water level, and is applied as follows: When the water has reached the desired height in the boiler, the copper tube is filled with water, and as the water in this tube is much below the temperature of the steam in the boiler, the tube is cooled and therefore contracts. When the height of the water level has been lowered the tube is filled with hot steam, and the heat causes it to expand. The lengthening and shortening of the tube gives motion to a small valve. When this valve is closed, the steam pressure in the regulating valve is increased, forcing the valve to its seat and shutting off the supply of water to the boiler. When the valve is open the steam escapes, removing the pressure on the regulating valve, and allowing it to open and admit water to the boiler. It is stated that the invention will regulate the water supply in three different ways: by the supply of steam to the pump; by shutting off the surplus water from the boiler; by allowing the surplus water to waste away. This latter is accomplished by shortening or lengthening the upper connection about an eighth of an inch, and is all the alteration required. The device, it is said, not only regulates the supply of water but records its operation by sounding a whistle whenever the steam is allowed to escape. Full particulars upon application.

"Throw Away Your Glue Pot"

WHY have the smell of boiling glue around you all day, and the waste and expense of boiling dry glue, when you can for less money use

ARMY AND NAVY LIQUID GLUE?

NOT A FISH GLUE but a pure hide and sinew glue in liquid form.

THE GLUE OF THE 20TH CENTURY

will do twenty-five per cent. more work than a fish glue. No smell. No dirt. Always ready for use.

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BALTIMORE, MD.

IMPROVED PATENT

Steam Steering Gear, Steam Windlasses and Capstans, Pilot House Stands and Wheels, Chase Patent Coal Elevators,

AND A COMPLETE LINE OF

Yacht Windlasses and Marine Machinery,

MANUFACTURED BY

THE TEXTILE-FINISHING MACHINERY CO.

17 Exchange Place, Providence, R. I.

ALSO MANUFACTURERS OF

Bleaching, Dyeing, Drying, and Finishing Machinery, and Improved Hot-Water Remover for Clearing, Drying Cylinders, and Heating Systems of Condensed Water and Air, and Returning Water to Boiler.

NEW YORK OFFICE, 39 CORTLANDT STREET.

THE PHILIP CAREY MANUFACTURING COMPANY, Lockland, Ohio, has received an order from the United States government for 10,000 feet of magnesia covering and a large quantity of magnesia cement, for use at the New York navy yard. The company states that this is but one of many similar orders received from the United States government.

THE BOSTON AND LOCKPORT BLOCK COMPANY, 160 Commercial street, Boston, Mass., made the blocks for the *Minnesota* and the *Dakota*, recently built by the Eastern Shipbuilding Company, New London, Conn. These blocks are made from a special design, and incorporate all the latest improvements. The cargo blocks are of steel and the boat blocks have wooden shells. The total weight of the outfit for each ship is about twenty tons, and the value is about four times as much as the cost of blocks required for an ordinary four-masted ship. The capacity of the largest blocks is from forty to sixty tons each.

THE HELIOS-UPTON COMPANY, Peabody, Mass., has received an unsolicited testimonial from one of its customers regarding the action of a No. 200 recording thermometer during the recent cold weather. The chart of this thermometer is divided into days, hours, and degrees, and the temperature is traced in red ink by a pen run by clockwork. The temperature range during the first week of January was unusually great, and the changes very sudden. The thermometer in question was put out early on a Monday morning and immediately the temperature fell until Tuesday morning 30 degrees below zero was recorded. It then rose sharply until the same afternoon the chart showed a temperature several degrees above zero. These and other sudden fluctuations of temperature were accurately recorded, and form a permanent record which it will be interesting to keep for comparative purposes.

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

WANTED.—ENGINEERS AND SALESMEN to handle France "Steam Stopper" brands of metallic and fibrous packings as a side line. Good inducements to right party. Address,
T. France Packing Company, Tacony, Philadelphia, Pa.

If any reader of MARINE ENGINEERING has Volumes I. and II. for sale, will he please communicate with MANISTEE, care Marine Engineering.

Marine Engineering EMPLOYMENT BUREAU.

Full information regarding the purposes of this bureau, together with instructions regarding registration, etc., furnished upon application to MARINE ENGINEERING Employment Bureau, 309 Broadway, New York city.

All correspondence, concerning either vacancies, or situations wanted, is strictly confidential.

VACANCIES.

The Employment Bureau has in hand inquiries for men for positions as follows:

Anglesmiths.
Foremen of Boiler Shop.
Superintendent of Launch Works.

SITUATIONS WANTED.

We have applications registered for positions as follows, and the references of each applicant have been carefully investigated:

Boiler Makers.
Carpenters.
Chief Draftsmen.
Draftsmen, general hull and engine.
Engineer for gasoline launch.
Foremen of yard, machine shop, and joiner shop.
Licensed engineers, chiefs, and assistants.
Loftsmen.
Machinists.
Masters.
Oiler.
Purchasing agent.
Salesman.
Superintendents.

WM. T. BONNER AND COMPANY, 53 State street, Boston, Mass., report that Klinger reflex gauges and Wiltbonco gauge mountings are becoming very extensively used not only in the United States and foreign navies, merchant ships, ferryboats, and private yachts, but also in many of the stationary power plants. These gauges were fitted to all the boilers on the United States torpedo destroyers which recently sailed from Norfolk to the Philippines.

THE UNITED STATES GUTTA PERCHA PAINT COMPANY, Providence, R. I., has made arrangements with Malcolm L. Pitts to put on the market his green anti-fouling paint. Mr. Pitts has had charge of all the painting and finishing at the Herreshoff Manufacturing Company's plant, Bristol, R. I., for twenty-three years, and during that time this paint was made and used under his supervision. It is well known how successfully the bottoms of the Herreshoff boats have withstood the action of barnacles and of all sea growth. The United States Gutta Percha Paint Company also makes steamship blacks, white lead, and zinc, and other specialties for the shipping trade.

Rainbow Packing

Makes Steam, Flange and Hot Water Joints Instantly

Thousands of Imitators.

No Equal.

Will Hold Highest Pressure.

Don't have to Use Wire and Cloth to Hold

RAINBOW

Can't Blow it Out.

THE COLOR OF RAINBOW PACKING IS RED

See that the Trade Mark (three rows of diamonds in black, connected) extends throughout the entire length of each yard or roll

WILL CARRY IN STOCK

It is an undisputed fact that Rainbow Packing is the only Sheet or Flange Packing in the world that will carry in stock for months and years without hardening or cracking

The Eclipse Sectional Rainbow Gasket

3/8 in.
1/2 in.
5/8 in.
} **For Hand Holes.**

3/4 in.
7/8 in.
1 in.
} **For Extra Large Joints.**

Fac-simile of a 6-inch Section of Eclipse Gasket showing Name and Trade Mark imbedded.

The Eclipse Gasket is red in color, and composed of the celebrated Rainbow Packing Compound. It will not harden under any degree of heat, or blow out under the highest pressure, and can be taken out and repeatedly replaced. Joints can be made in from three to five minutes.

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209-211 Magazine St., New Orleans, La.
202-210 S. Water St., Chicago, Ill.
1221-1223 Union Avenue, Kansas City, Mo.
634 Smithfield St., Pittsburg, Pa.
17-23 Beale St. and 18-24 Main St. San Francisco, Cal.

These Goods can be Obtained at All First-class Dealers.

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" 6, Wm. Arste, 322 Pine St., St. Louis, Mo.
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" 85, John A. Packard, 623 Merchant St., Alpena, Mich.
" 86, Sherman A. Smith, 737 Menekaunee Ave., Marinetta, Wis.
" 87, Geo. B. Milne, 809 Fourth St., Detroit, Mich.
" 88, C. O. Chapman, S. B. Canal, Sturgeon Bay, Wis.
" 89, Geo. E. Willard, 4 Isabella St., Ogdensburg, N. Y.
" 91, A. L. McLaren, 130 W. Walnnt St., Ashtabula, O.
" 92, Jos. D. Budd, Box 50, Sta. I, Saginaw, W. S., Mich.
" 93, W. J. Cook, 2220 G. St., N. W., Washington, D. C.
" 94, Geo. R. Jones, Box 222, Washington, N. C.
" 95, P. J. McMahon, Box 199, Key West, Fla.
" 98, Bert Hamlin, 114 Exchange Place, New Orleans, La.
" 100, Jas. P. Lynch, Honolulu, H. I.
" 101, J. K. Cotton, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., South Haven, Mich.
" 103, A. E. Pittman, Box 378, New Bern, N. C.

TRADE PUBLICATIONS.

The 1904 Model Gas Engines manufactured by the Mianus Motor Works, Mianus, Conn., are described in a concise folder, a copy of which will be sent to all inquirers.

The kerosene oil engines which are manufactured by the International Power Vehicle Company, Stamford, Conn., are illustrated and described in a four page folder which this company is sending to all who are interested in this kind of engine.

A fine view of the after section of the S. S. *Minnesota*, is shown on the mailing card issued by Joseph Dixon Crucible Company, Jersey City, N. J. The card states that the hull of this ship was primed with Dixon's Silica-Graphite paint.

The Phosphor-Bronze Smelting Company, Ltd., 2200 Washington avenue, Philadelphia, Pa., is distributing price list No. 22, which cancels all previous quotations. This company has just installed a new rolling mill, which has largely increased facilities for filling orders for phosphor-bronze and other alloys.

The Foos Gas and Gasoline Engines which are designed exclusively for stationary work, have a complete catalogue devoted to them, issued as No. 12 by the Foos Gas Engine Company, Springfield, O. Many illustrations 6 by 8 inches in size, show not only the design of the engine, but the detail of its construction and different applications.

A convenient pocket memorandum book will be sent free to all inquirers through Marine Engineering, by George N. Gardiner & Son, 53 South street, New York, N. Y. It contains a 1904 calendar, information regarding population of cities, together with tables of weights, measures, postal rates, and much other such information, in addition to oil sheets for protecting stamps, and diary for each day in the year.

The New York Sky Line is published as an advertisement by P. and F. Corbin, New Britain, Conn. It makes a very handsome picture, about 8 by 36 inches in size, and shows New York as seen from the North river, from the Washington building at No. 1 Broadway, to the New York Life Insurance building at 346 Broadway. We understand that copies of this picture will be sent to all inquirers who mention Marine Engineering.

The charging outfits manufactured by the Westinghouse Electrical Manufacturing Company, Pittsburg, Pa., for both electric launches and automobiles, are thoroughly illustrated and described in Circular No. 1061, just issued. Another publication just issued by this company, is folder No. 4006, which describes the Westinghouse auxiliary apparatus for railway equipments.

"Machine Tool Equipment" is the subject of a series of folders, issued by the Crocker-Wheeler Company, Ampere, N. J. These folders describe electric motors furnished by this company for operating machine tools in manufacturing plants of various kinds. Bolt cutters with motor drive; 24-inch motor-driven lathe, turret lathes with motor drive; milling machines with motor drives; boring machines electrically driven, and plate-bending rolls using Crocker-Wheeler motors, are among the examples described and illustrated in these folders.

"Marine Gasoline Engines" is the title of a 76-page catalogue, issued by the Charles A. Strelinger Company, Detroit, Mich. The catalogue describes in much detail, the various sizes of engines manufactured by this company, and gives a great deal of practical and valuable information regarding the general subject of explosive engines, together with detailed instructions as to selecting an engine, and particularly as to operating it when installed on a boat. Any reader interested in gasoline engines will find an immense amount of information in these 76 pages.

"Black Squadron Packing," as manufactured by the Cancos Manufacturing Company, 146 North Second street, Philadelphia, Pa., is the subject of several verses in a folder which this company is distributing.

The Branch Steam Trap, "the trap that made St. Louis famous," is illustrated and described in Steam Bulletin 10, issued by the National Oil Burner and Equipment Company, Holland Building, St. Louis, Mo.

"Hoists and Mining Machinery," operated by gasoline, naphtha, kerosene, and other oils, is the subject matter of Catalogue No. 45 B, issued by Fairbanks, Morse & Company, Franklin and Monroe streets, Chicago. It is neatly printed in two colors, and large illustrations are given of various applications of these engines for hoisting and mining purposes.

The Vulcan Iron Works Company, Toledo, O., which manufactures dipper dredges, steam shovels, etc., is sending to all inquirers without charge, a neat and convenient pocket memorandum book which contains in addition to a calendar and colored map of the United States, much information in the way of postage rules, population of cities, etc.

The launch propellers, reversing gears, deck lights, row locks, cleats, stanchion posts, mast plates, and other marine specialties manufactured by the Norwalk Brass Company, Norwalk, Conn., are thoroughly illustrated and described in the 1904 catalogue. A copy of this catalogue should be in the hands of every concern which has to do with small craft of all kinds.

"The House of Corbin" is the title of a beautifully printed book just issued by P. & F. Corbin, New Britain, Conn. As a specimen of printing it is one of the most beautiful we have ever seen. It contains fine portraits of all the men who have been connected with this firm, and gives a great deal of information regarding the hardware which it manufactures.

The various kinds of packing manufactured by the Crandall Packing Company, Palmyra, N. Y., will be found described in a complete and well-arranged catalogue of 54 pages which this company is now distributing. Every user of packing will want to send for a copy which will be sent gratis upon application. The catalogue is well illustrated.

The Toquet Marine Motor will be found fully described in the catalogue which is distributed by the Toquet Launch Company, Saugatuck, Conn. The pictures of the engine are large, showing fully its design, and each feature of the engine is described, so that the would-be purchaser can secure a most comprehensive idea of the several features of this engine. Copies are sent free to all inquirers.

Machine tools for shipyards and boiler shops will be found illustrated in great variety in a 28-page catalogue issued by the Hilles & Jones Company, Wilmington, Del., designated as Catalogue T. The catalogue is about 9 inches square and on each page are engravings of from one to four different types of machines. The printing is excellent and the catalogue one that should be on file in every yard.

"The Subject of Brick Drying" will be found discussed in a comprehensive manner in Catalogue No. 159, which is distributed by the American Blower Company, Detroit, Mich. The catalogue is handsomely printed and profusely illustrated, so that the subject matter is made very plain even to the uninitiated. A number of fine illustrations are given of large plants equipped with this company's drying system.

"Launches and Yachts" is the title of a handsomely published catalogue which the Electric Launch Company, Bayonne City, N. J., is distributing. It contains 120 pages very finely illustrated and printed. Launches and yachts in great variety are shown in the illustrations, and each type is described both in its construction as well as in its equipment, capacity, etc. Any one contemplating the purchase of a launch or yacht will find this catalogue of great value.

GEORGE WASHINGTON'S example for telling the truth is being well perpetuated by

The Starrett High Speed Indicator

which tells the exact truth about a shaft's revolutions. The working parts of this Indicator are encased, and the dial plate has two rows figures, reading right or left, as the shaft may run.

AN IMPORTANT IMPROVEMENT

applied to all our Indicators is the use of **Rubber Tips** for pointed or hollow centers on the hardened steel pointed spindles.

Send for our FREE CATALOGUE No. 17L, which tells of all the STARRETT TOOLS.

THE L. S. STARRETT CO., ATHOL, MASS.

CONDENSER TUBES

last longest if made of

"BENEDICT-NICKEL"

ELECTROLYSIS is positively resisted because "Benedict-Nickel" is an alloy of nickel and copper.

CORROSION is impossible, as the tubing is so perfectly homogeneous.

Our treatise on "Electrolysis of Condenser Tubes" is very valuable and costs you nothing. Send for it.

BENEDICT & BURNHAM MFG. CO.
WATERBURY, CONN.
New York, 253 Broadway Boston, 172 High St.

DIXON'S Graphite Cup Greases are compounded of pure flake graphite and high-grade greases.

The lubricating value of this mixture far surpasses that of any plain grease and is especially well adapted to the heavy duty of marine engines.

In six grades, described in Booklet 75-I. Samples upon request.

JOSEPH DIXON CRUCIBLE CO.
Jersey City, N. J.

Volume blowers and exhausters are briefly and concisely illustrated and described in a handsome brochure of 20 pages, issued by the Buffalo Forge Company, Buffalo, N. Y.

Every engineer will want to send for a copy of the little folder issued by James L. Robertson & Sons, 204 Fulton street, New York, N. Y., entitled "On the Only Unit of the Planimeter."

"The Specializing of Interior Telephone Apparatus" is the subject matter of Bulletin No. 1, issued by the Electric Gas Lighting Company, 195 Devonshire street, Boston, Mass. This catalogue comprises 32 pages, giving much information regarding different types of telephones and included are wiring diagrams.

The hydraulic leather packing, manufactured by the Detroit Leather Specialty Company, Detroit, Mich., has a special folder devoted it. The value of these packings for various marine uses, including use in steam tubes, will be appreciated. Copies of the catalogue may be had upon application.

Users of the sparking devices should send for a copy of the 1904 catalogue issued by the Remy Electric Company, Anderson, Ind., describing this company's ignition apparatus. The different types of magnetos are illustrated and each one described separately. This, together with other information on the subject, makes the catalogue of much value.

The Improved Cincinnati Air Compressor is the latest bulletin issued by the Laidlow-Dunn-Gordon Company, Cincinnati, O.

The Englehardt Collapsible Life Boat is illustrated and described in a neat folder issued by the Engelhardt Collapsible Life Boat Company, 305 Vernon Ave., Long Island City, N. Y.

The Dutton Engineering Company, Perth Amboy, N. J., is distributing a folder containing unsolicited testimonials from users of the gas engines and launches which this company manufactures.

H. B. Willson & Company, Eighth and F streets, N. W., Washington, D. C., are distributing a booklet giving much information regarding patents both domestic and foreign.

The Standard Pressed Steel Company, Twentieth and Clearfield streets, Philadelphia, is distributing a pocket-sized catalogue describing the hangers and other pressed steel specialties which it manufactures.

"The Steam Radiator," by "Bill Nye," is the title of an 8-page pamphlet being distributed by Warren Webster & Company, Camden, N. J. The wit of this author is too well known to need comment.

"'One Snap' Air Ports" is the subject of the latest booklet issued by the Delaware Marine Supply Company, Wilmington, Del. It comprizes 16 pages, and contains a number of illustrations of these ports and other marine specialties of this company.

The kerosene oil engines and the reversing friction clutch manufactured by the August Mietz Iron Foundry & Machine Company, 128 Mott street, New York, N. Y., are illustrated and described in a folder which this company has issued.

"Everything in the Indicator Line" is the caption of a hanger which James L. Robertson & Sons, 204 Fulton street, New York, are sending to all inquirers. On the hanger are a dozen or more illustrations of indicators and attachments.

A calendar for each month, leaving space for daily memoranda, is being distributed by the Crandall Packing Company, S. M. Hildreth, manager, 123 Liberty street, New York, N. Y. Readers of Marine Engineering who wish copies of this calendar sent each month need only to ask for them.

"Hotel Annunciator Practices" is the title of a booklet which is being distributed by the Electric Gas Lighting Company, 195 Devonshire street, Boston, Mass. It illustrates and describes a number of installations which the company has recently made, and gives considerable information on the subject of annunciators.

"Alternators" is the title of Catalogue No. 60 now being distributed by the National Electric Company, Milwaukee, Wis. The catalogue is neatly bound in green paper and is printed in colors. The text gives much information regarding alternating current machinery which every electrician will find of interest.

WATCH THIS SPACE FOR OUR NUMEROUS SPECIALTIES.

WALWORTH MFG. CO. TOOLS and SUPPLIES for STEAM WATER and GAS USERS BOSTON MASS

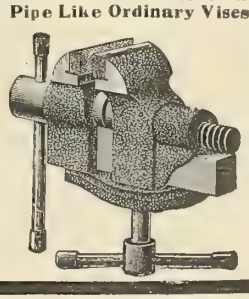
Walworth Extra Heavy Bench Pipe Vise

Is made especially for use in

MARINE REPAIR SHOPS AFLOAT AND ASHORE.

Grips pipe 1/8 to 6 inches inclusive, and by reason of its solid and substantial "make up," also furnishes a first-class tool for general machine work.

Will not Crush or Jam Pipe Like Ordinary Vises



JOBBERS SELL THEM—IF YOURS DON'T, WRITE.

New York, Park Row Building. **WALWORTH MFG. CO.,** Boston, 128 Federal Street.

Write for our BLUE CATALOGUE "D." showing complete line of engineers' pipe fitting tools.

BUSINESS NOTES.

Change of name. The Pittsburg Shear Knife and Machine Company, Pittsburg, Pa., has changed its name to Heppenstall Forge and Knife Company.

Graphite pipe joint compound is sold in collapsible tubes by the Joseph Dixon Crucible Company, Jersey City, N. J. The company states that this tube is especially useful for small work away from the shop and for those who have only occasional need of making threaded connections. Each tube contains about four ounces of the compound and is provided with a small opening closed by a screw cap, thus thoroughly protecting the contents from drying. The paste is squeezed directly upon the threads, making unnecessary the use of a swab, and preventing the soiling of hands or clothes. The method is economical as it saves the waste of the ordinary daubing of the threads, and enables a small amount to be kept constantly on hand for immediate use, saving annoying delays.

Packing tools free. The Mound Tool and Scraper Company, 712 Howard street, St. Louis, Mo., will send for this month only, a souvenir packing tool free to any engineer who mentions that he has seen the offer in Marine Engineering. The company sells a set of six scraping tools in an oak case, in two styles, which it is said are used by leading engineers and by the navy. Of Mound cold chisels the company states that they are made of a high grade crucible steel, thus insuring good results in forging and tempering. These chisels are made up in sets of five: a flat chisel, a narrow cape chisel, a bent grooving chisel for cutting oil ways in engine brasses and bearings, and a diamond point and calking tool suitable for calking seams and boiler rivets. The packing tools the company makes are claimed to fit into any valve rod pump or engine stuffing box, and are warranted not to break in removing packing.

Speedy motor boat. The Lozier Motor Company, of New York City, states that the speed question is going to play an important part in motor boating this year, but believes the demand will be for boats of moderate speed rather than for the extreme type of high-speed automobile racers. This company is building a large number of boats at its New York City works at the mouth of Westchester Creek, and at present has 28, 31, 33 and 40 footers under construction. These boats are termed semi-racers and will have a speed which will enable them to easily run away from the ordinary type of motor boat. For advertising purposes the company is building an automobile boat 25 feet in length to attain very high speed. The hull will weigh less than 500 pounds and will be equipped with a 24x30 Lozier automobile engine turning an 18-inch wheel 1000 R. P. M. The total weight of the hull and engine will be less than 900 pounds. It also has an automobile racing boat 37 feet in length in course of construction at its New York City shops. At the present time the Lozier Motor Company is building at its works at Plattsburg, N. Y., one hundred and fifty launches 21 and 25 feet in length, one hundred of which have been completed and are ready for delivery. At the New York City works in addition to the semi-racers and automobile boats, the following are building: one 50-foot oyster boat, one 32-foot twin screw, shallow draft work boat for Texas, one 21-foot yacht's tender, one 31-foot cruising launch, one 25-foot boat with five windows forward, and several small tenders.

GENERAL MACHINE WORK

Model and Experimental Work
Plans and Specifications Prepared
Prompt Repair Work

ACORN ENGINEERING & MANUFACTURING CO.
27 THAMES STREET, - - NEW YORK, N. Y.

A NEW BOOK

(To be ready about May 15)

USES OF ELECTRICITY ON SHIPBOARD.

By J. W. Kellogg,
Manager Marine Sales Dept., General Electric Company.

The first chapter deals with the early installation of electric equipment both in this country and in England, and outlines briefly the systems installed.

Chapter II. deals with the considerations for modern plant, first, in the selection of an engine of suitable design and size, and next in the selection of a suitable number and size of units, locating them properly, the necessity of perfect lubrication of both engine and generator, and the proper care of the plant.

The third chapter gives a thorough treatment of wiring and insulation, considers the advisability of installing steam turbine, advises as to distribution of current, and proper size of the mains. In further sections the single and double-wire circuits as installed in English and American ships, and the desirability of the third-wire circuit are considered. The last paragraph takes up the requisite sizes and location of the distributing wires.

Chapter IV. is devoted to electric fixtures, fittings, joints, ducts, insulation, and other minor details which, however, are of the utmost importance for the successful operation of a plant. Many illustrations are given of these details as on the market.

Chapter V. Electricity is being used more and more every day for running auxiliaries and chapter five is devoted to a sketch of what is the most recent practice in this line. The use of the electric storage battery on board ship is also considered.

In Chapter VI. is taken up a specific case of wiring for a small steamer. The lay-out of the mains is considered and the reason given for final arrangement. Full details of sizes, number of lights on each circuit, and location of them are stated. For this chapter two large drawings illustrate the wiring plan at the dynamo, and the location of the distributing panels on board the ship.

The book is neatly bound in cloth, and is fully illustrated.

Price $1.00

Orders received now by

MARINE ENGINEERING, 309 Broadway, New York

THE STORY OF PHOEBE SNOW.

If you have ever taken a railroad trip you will enjoy the "Story of Phoebe Snow," which describes in a series of dainty pictures the experiences of a pretty girl who went to Buffalo. The illustrations are in seven colors, each reproducing a design of the girl in white which the Lackawanna Railroad has made so familiar in the last few months. The booklet has a particularly pleasing cover and will afford considerable amusement beside giving information which every traveler ought to know. It will be sent in response to request, accompanied by two cents in stamps, to T. W. Lee, General Passenger Agent, New York City.

"ZINC WHITE is more oxothermic, and hence very staple and more resistant to atmospheric influences, so that painting done with it is more lasting than painting done with white lead."

J. GIRAUD,

In *Oil and Colourman's Journal.*

All high-grade ready-mixed and combination paints are based on

ZINC WHITE

Pamphlets valuable to paint consumers mailed free on request:

"The Paint Question,"
"Paints in Architecture,"
"Specifications for Architects," and
"French Government Decrees."

THE NEW JERSEY ZINC CO.
71 BROADWAY
NEW YORK

We do not grind zinc in oil. A list of zinc paint manufacturers is furnished on request.

The Standard Gauge Manufacturing Company, Syracuse, N. Y., has opened a Western branch at 58 West Washington Street, Chicago, Ill., The Company states that it will carry in stock at Chicago, a full line of "Standard" self-contained pressure and vacuum gauges, and similar engineering specialties. The office will be in charge of the company's treasurer, Mr. W. G. Holbrook.

Fire Hose for New York City. The Republic Rubber Company, Youngstown, Ohio, announces the successful test of its white shield brand of fire hose by the City of New York. It states that the required specifications were the most rigid and exacting ever issued by any city. The fact that White Shield brand stood the test in detail as to cover, duck, friction and tube, establishes this brand, it is claimed, as among the best constructed and highest quality of fire hose manufactured.

E. C. Johnson and Company, Nyack, N. Y., have taken over the business of the Pinckney Company of the same place. The head of the new firm, Mr. E. C. Johnston, recently came over to this country to establish a launch-building yard, to construct seamless steel boats on the improved Wakefield plan, and to build wooden vessels on the new patented system of labor-saving appliances. Mr. Johnston served apprenticeship on the Clyde, and has been in the business for over twenty-five years and has been employed by several of the largest Scotch and English shipbuilders as machinist, draftsman, foreman, and manager.

Managers in Convention. A convention of branch managers, department managers and salesmen of the H. W. Johns-Manville Co., was held in Hartford, Conn., and New York City from February 15th to February 20th. About thirty-five representatives from all parts of the country were present, the company having branches in New York, Milwaukee, Chicago, St. Louis, Boston, Philadelphia, Cleveland, Pittsburg, New Orleans and London. The delegates first met in Hartford where they were the guests of the Johns-Pratt Co., manufacturer of electrical goods for which the H. W. Johns-Manville Co. is sole agent. The object of the convention was to bring all branches into closer touch with each other and to give opportunity for a general discussion of all the lines manufactured by the company.

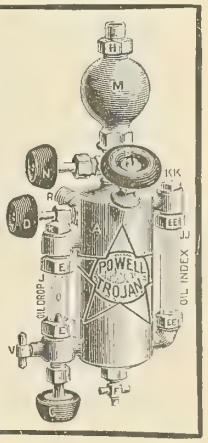
The Sportsmen's Show.—The tenth annual Sportsmen's Show, which was held in Madison Square Garden, New York, N. Y., February 19 to March 5, was by all odds the most satisfactory show that has yet been held. There were many exhibits by launch and gas engine concerns, and they very generally report a most excellent trade in the number of engines and launches held. Among the exhibitors were the following: Victor Metals Company, New York, N. Y., a complete line of boat and yacht fittings made of Victor metals; August Mietz, New York, N. Y., launch engine operated by kerosene; Buffalo Gasolene Motor Company, Buffalo, N. Y., several sizes of launch engines; Richardson Engineering Company, Hartford, Conn., searchlamps and other electric fittings for launches; the Fairbanks Company, New York, N. Y., launch engines; the Lackawanna Motor Company, Buffalo, N. Y., several sizes of launch engines; the Charles A. Strelinger Company, Detroit, Mich., several launch engines; the Standard Motor Construction Company, Jersey City, N. J., engines and hulls; Eagle Bicycle Manufacturing Company, Torrington, Conn., several engines, also hulls; Electric Launch Company, Bayonne, N. J., several electric launches of different sizes; Lozier Motor Company, Plattsburg, N. Y., several engines and hulls; the C. H. Blomstrom Motor Company, Detroit, Mich., standard outfits of hull and engine complete; the Pierce Engine Company, Racine, Wis., two or three sizes of hulls with engines complete.

THE POWELL "TROJAN" SIGHT UP-FEED LUBRICATOR

NOTE THE LATEST IMPROVEMENTS:

The condenser M is a separate piece. It screws on to the water valve N. In case the condenser breaks, and while waiting for repairs, the lubricator can be continued in service by inserting a short nipple. Unscrew coupling H from condenser pipe, insert a short nipple and socket, replace coupling H and connect to water valve N. The threads in coupling and on neck of water valve are same number and gauge. All engineers will appreciate this improvement.

Of course "IT WORKS," the name is especially applicable.



THE WM. POWELL CO., Cincinnati, Ohio, U. S. A.

Everything in the steam line for the boiler and engine room.

New York Agent: H. H. BEALS, 51 Cliff St. Philadelphia Agent: C. J. RAINEAR & CO., 518 Arch St.

The British Johns-Manville Company, Limited, has been incorporated in England with offices and warerooms at 81 Fenchurch street, London, E. C., and will handle a complete line of overhead line material, vulcareston, moulded mica, and Monarch insulations, especially adapted for insulating railway motors, generators, controllers, arc lamps, switch handles, switch boxes, and various other pieces of apparatus requiring a high-grade insulating material; also a complete line of electric heaters, rail bonds, and Sachs Noark enclosed fuse protective devices. The new company will carry a full stock of supplies at the London office, which will enable it to make prompt deliveries and give good service at all times. Mr. Henry J. Joseph is the managing director of the new company, as well as manager of the London branch of the H. W. Johns-Manville Company, with offices at the same address.

Henry J. Gielow, naval architect and yacht broker, 50 Broadway, New York, N. Y., reports that he has sold the steam yacht *Felicia*, formerly belonging to E. W. Bliss of the New York Yacht Club.

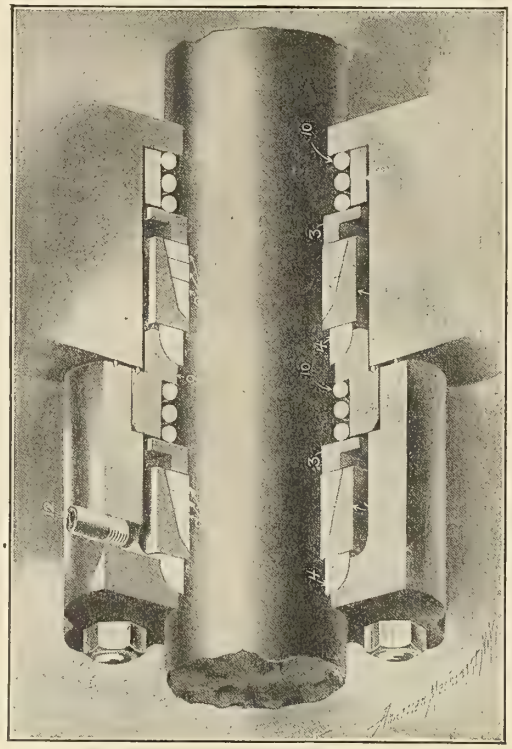
T. S. Marvel & Company, Newburg-on-the-Hudson, N. Y., state that they have a large marine railway and excellent facilities for repairing iron and wood vessels, engines and boilers, besides building them. Many of the ferry and tugboats seen about New York harbor are the product of their yard.

The Goldschmidt Thermit Company, 41 Wall street, New York, N. Y., has incorporated for the purpose of exploiting in America the alumino-thermic process of producing high temperatures by burning aluminum. A complete description of this welding process may be found in the January, 1904, issue of Marine Engineering.

United States Metallic Packing

For Piston Rods and Valve Stems of Marine Engines

Price Low



Class No. 1 Packing.

20 Years Reputation for Satisfactory Reliable Efficient Service

Repairs cheap and easily made

PACKINGS RUN YEARS WITHOUT ATTENTION

CATOLOGUE, PRICES, AND LIST OF USERS ON APPLICATION.

The United States Metallic Packing Company

MAIN OFFICE AND WORKS, 427 No. Thirteenth Street, PHILADELPHIA, PENNA.

CHICAGO, 1509 Great Northern Bldg. SEATTLE, Moran Bros. SAN FRANCISCO, W. H. Pierson

IMPROVED PATENT

Steam Steering Gear, Steam Windlasses and Capstans, Pilot House Stands and Wheels, Chase Patent Coal Elevators,

AND A COMPLETE LINE OF

Yacht Windlasses and Marine Machinery,

MANUFACTURED BY

THE TEXTILE-FINISHING MACHINERY CO.

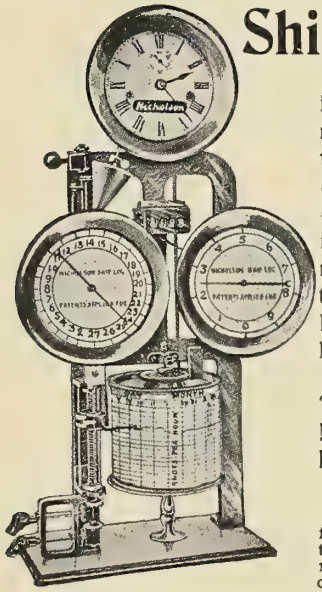
17 Exchange Place, Providence, R. I.

ALSO MANUFACTURERS OF

Bleaching, Dyeing, Drying, and Finishing Machinery, and Improved Hot-Water Remover for Clearing, Drying Cylinders, and Heating Systems of Condensed Water and Air, and Returning Water to Boiler.

NEW YORK OFFICE, 39 CORTLANDT STREET.

The Nicholson Perfected Ship Log



is the only log that accurately shows the speed of the moment of a ship, on a dial, and records this speed on a paper chart for every minute of the trip. It also registers the distance travelled. No line overboard. Placed in chart house or wherever desired.

THE NICHOLSON MARINE DISTANCE FINDER

Advantages Claimed:

The exact distance from any fixed point can readily be determined without any mathematical calculation. Anyone can easily learn to use it.

NICHOLSON SHIP LOG CO.

204 Superior Street, Cleveland, Ohio, U. S. A.

W. H. PIERSON, 421 Market St., San Francisco.
ROBT. SNOWDON, 107 High St., Boro, London, S. E., England.
ARTHUR BEHRENS, Fontanka, 52, St. Petersburg, Russia.

Boilers for Battleships. The Babcock & Wilcox Company, 85 Liberty street, New York City, states that the British admiralty has ordered Babcock & Wilcox boilers for the new battleships *Britannia, Hibernia* and *Africa*. Each vessel will have 18,000 I. H. P. boilers in eighteen units. Babcock & Wilcox boilers have also been ordered for the Italian battleship *Napoli*. This vessel will be equipped with twenty-two boilers.

Uses and Importance of Asbestos.—The New Jersey Asbestos Company, Camden, N. J., states in a circular: "Asbestos is a paradox among minerals. Although mined like anthracite coal, its fibres, when separated by machine from the rock are soft, white and delicate—resembling wool or cotton, though not inflammable. The principal supply of crude asbestos, suitable for commercial use, comes from Canada. As it comes from the mine it costs $200 per ton. The fibres after separation are worth $1500 per ton. The fibres are made into yarn, and woven into cloth in much the same way as is done with cotton. It is then made into packing in various forms, sheeting, tapes, gaskets, theatre curtains, furnacemen's aprons, leggings, firemen's clothes, gloves, etc. The developments in the use of high-pressure engines during the last ten or twelve years, has rendered necessary corresponding improvements in jointing and packing materials. The New Jersey Asbestos Company began the manufacture of asbestos sheeting, spinning a fine brass wire into the center of the threads of both warp and weft, thereby adding strength, and making it capable, it is claimed, of resisting the highest pressure. It is rendered waterproof by a coating of India rubber. The company says this packing met such approval from engineers in general that it secured patents on a number of styles of packing and gaskets, and placed them on the market under the trade mark of the Gladiator asbestos-metallic goods. That these continue to give satisfaction to engineers is indicated by the additional machinery the company adds to its plant from time to time.

The Allis-Chalmers Company, New York Life Bldg., New York City, announces that it has engaged in the manufacture of steam turbines, gas engines, hydraulic and electrical machinery. It is associated with and forms part of the Turbine Advisory Syndicate of England, comprising Yarrow Shipbuilding Company, Tweedie (Vulcan) Shipbuilding Company, Willans & Robinson, and Mr. Fullager, formerly Chief Engineer of the Parsons Steam Turbine Company, of England. It will build steam turbines of the horizontal type which the company claims to be the leading steam turbine on the market, in units from 500 to 10,000 K. W. capacity. The Company's license concedes exclusive rights for the United States, Canada and Mexico, with equal rights in South America, and privilege to carry on business elsewhere in the western hemisphere. It is the sole licensee of the hydraulic machinery of Escher-Wyss & Co., Zurich, Switzerland, who have designed upwards of 85,000 H. P. installed at the Niagara Falls plant of the Cataract Construction Company. It has acquired the American patents and is the sole licensee for the western hemisphere of the Nurnberg Gas Engine, built by the Nurnberg Machinery Co., Nurnberg, Germany, and will build gas engines from 260 to 6000 H. P. The Nurnberg Gas Engine operates with natural, producer, coke-oven, blast furnace, and illuminating gas. The Allis-Chalmers Company manufactures electrical machinery, such as generators, motors and other apparatus for stationary, railway power house and electric light purposes. The electrical department will be in charge of Mr. John F. Kelly, formerly of the Stanley Electric Mfg. Company, and Mr. William Stanley, of same company, will act as consulting engineer. The company invites specifications of requirements for any machinery that it manufactures and promises improved designs and the highest class of workmanship.

The American Bureau of Shipping, 66 Beaver street, New York, N. Y., reports the following vessels classed and rated: American screw *Danville,* American screw *Aztec,* American screw *Benefactor,* American screw *Colon,* American screw *Missouri,* Cuban screw *Manzanillo,* Cuban screw *Yumuri,* American schooners *Henry F. Kreger, Helen Thomas, Eaglet, Salisbury, J. R. Teel;* American three-masted schooners *John M. Brown, Fred W. Ayer, S. P. Hitchcock, Jennie Lockwood*; American half-brig *Atalanta,* American barges *Gusher, Spindletop;* British barkentine *Trinidad,* British three-masted schooners *Helen, Bartholdi;* British topsail tern *Rescue,* British bark *Swansea;* American screw *Wyomissing,* American schooner *James B. Drake,* American three-masted schooner *D. J. Sawyer,* British three-masted schooner *Mona,* British three-masted schooner *Caledonia,* American screw *Mongolia,* American screw *Conestoga,* American screw *Umatilla,* American schooner *Winfield S. Schuster,* American three-masted schooner *George D. Edmands,* American barge *Beattie.*

Gio. Ansaldo and Co., Sampierdarena, Genoa, Italy, shipbuilders and iron workers, have combined with Sir W. G. Armstrong and Co., Newcastle, England. It is stated that the shipbuilding establishment of Ansaldo and Co. at Sestri Torrente, the marine engine plant at Sampierdarena, the fitting and repair shops in Genoa harbor, the steel foundry and the Delta's bronze foundry at Cornigliano, have been turned into a joint stock company, and that half of the capital stock of thirty million lire has been furnished by Armstrong and Company, and the other half by Ansaldo and Company. The Armstrong ordinance factory near Naples is not included in this arrangement. The Ansaldo business in all its branches employs about 3,500 men. It is planned to build naval vessels at the Sampierdarena yard, and to equip them with Armstrong guns. The Ansaldo yard has built many war vessels, including those built for Chili and Argentina which were purchased by England and Japan; also two torpedo boats for Turkey, besides being engaged in repairing six Turkish naval vessels.

The Star Improved Indicator.—The Star Brass Mfg. Co., 108-114 East Dedham Street, Boston, Mass., is distributing a circular describing the Star improved steam engine indicator, outside spring type, designed expressly for use under the extreme high pressure carried at the present time. The Bureau of Steam Engineering, U. S. Navy Department, decided that all indicators hereafter to be furnished the United States Government for the Navy Department shall be of the external or outside spring type. It has many advantages owing to size and lightness of its moving parts, and owing to the fact that the weight of the moving parts has not been increased due to the adoption of the outside spring. The construction of this instrument varies in several ways from the Star inside spring type of indicator as follows: The area of the piston has been reduced from one-half of one square inch to one-quarter of one square inch, thus allowing of the use of a much smaller size of wire for springs, to secure greater elasticity and freedom of operation. The spring is elongated or pulled apart instead of being compressed or pushed apart. The operation of pencil movement is directly opposite to that used in the inside spring types, viz., the atmospheric line is at the top of drum instead of at the bottom. The connection to cylinder is at side instead of at the bottom; owing to this construction the company furnishes with indicator an angle cock, for connection to horizontal types of engines. The cylinder can be readily removed for examination or replacement without in any way interfering with the other parts of the indicator. The end of the cylinder has no connection with the outer wall of the indicator. This allows the cylinder to be surrounded by live steam, practically forming a steam jacket. By unscrewing cap from lower end of cylinder, the piston can be removed with socket wrench, for cleaning or oiling, without in any way disturbing other parts of the indicator.

"Throw Away Your Glue Pot"

WHY have the smell of boiling glue around you all day, and the waste and expense of boiling dry glue, when you can for less money use

ARMY AND NAVY LIQUID GLUE?

NOT A FISH GLUE but a pure hide and sinew glue in liquid form.

THE GLUE OF THE 20TH CENTURY

will do twenty-five per cent. more work than a fish glue. No smell. No dirt. Always ready for use.

Let us send you Samples and Prices

Wachter Mfg. Co.

BALTIMORE, MD.

Engineering Data Cards

MANY readers of Marine Engineering, who keep careful record of all data regarding ships, engines, etc., do not want to mutilate their copies of the magazine by cutting out the data cards which are published each month, and yet desire to keep the data in card form.

For the accommodation of such readers, we are now republishing all such data on cards.

Many cards are now ready for distribution. It is not known how many cards will be issued during the year, so instead of making a yearly rate, the cards are sold as subscribers wish them.

The price is as follows:

To Subscribers, Five Cents per Card
To Non-Subscribers, Ten Cents per Card

All orders placed now can begin with the series and have all the cards issued up to date.

For sample cards and further information, address

MARINE ENGINEERING
309 Broadway New York City

Machinery for Mexico. The Marine Iron Works, Chicago, Ill., states that it has shipped a carload of horizontal tandem compound condensing paddle-wheel machinery to Mexico for a 135-ft. river boat. The company says that it has received many orders from Eastern naval architects for fore-and-aft compound or triple expansion machinery.

The annual meeting of the Boston and Lockport Block Company, Boston, Mass., was held on Feb. 24th, and in addition to regular routine business, the matter of a new plant was considered, and orders given to have plans submitted to the directors at any early date. The Company is preparing a display for the St. Louis Exposition.

"No Great Loss Without Some Small Gain."—Even the fire which recently swept a large part of Baltimore will benefit some. The salvage companies who salvage goods and sell them for the benefit of the fire insurance companies, will profit by this loss. The goods damaged must be dried before they become saleable, much depending upon the success of this drying. The Underwriters' Salvage Company of New York City recently placed an order with the B. F. Sturtevant Company of Boston, Mass., for the complete equipment of a kiln for drying such goods by the Sturtevant fan system. The kiln is divided into small rooms of various widths, served by overhead tracks from which are suspended frames for supporting two tiers of baskets for the reception of the watersoaked material. These rooms are of fireproof construction. Hot air is diffused through the rooms, and the amount of air and its temperature is easily controlled. The drying is economical and independent of the weather. The kiln is not only equipped with the Sturtevant apparatus for drying, consisting of a Sturtevant steam fan connected to a Sturtevant fireproof heater and galvanized iron distributing pipes, but the entire material and workmanship for making the rooms fireproof was furnished by the B. F. Sturtevant Company.

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line. Lines average ten words each.

Instructor in naval architecture and marine engineering in eastern college desires change of position. College graduate, with shipyard and drafting-room experience. Best of references. Address, Naval Architecture, care Marine Engineering.

Marine Engineering EMPLOYMENT BUREAU.

Full information regarding the purposes of this bureau, together with instructions regarding registration, etc., furnished upon application to Marine Engineering Employment Bureau, 309 Broadway, New York city.

All correspondence, concerning either vacancies, or situations wanted, is strictly confidential.

VACANCIES.

The Employment Bureau has in hand inquiries for men for positions as follows:

Anglesmiths.
Foremen of Boiler Shop.
Master for a Racing Sloop.
Superintendent of Launch Works.

SITUATIONS WANTED.

We have applications registered for positions as follows, and the references of each applicant have been carefully investigated:

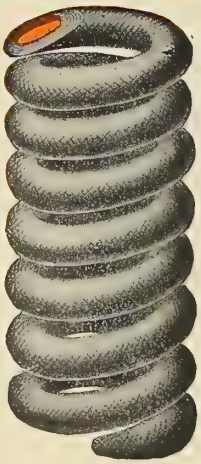
Boiler Makers.
Carpenters.
Chief Draftsmen.
Draftsmen, general hull and engine.
Engineer for gasoline launch.
Foremen of yard, machine shop, and joiner shop.
Licensed engineers, chiefs, and assistants.
Loftsmen.
Machinists.
Masters.
Oiler.
Purchasing agent.
Salesman.
Superintendents.

Paroid Roofing.—In a neat pamphlet, issued by F. W. Bird & Son, East Walpole, Mass., designed to show a few of the "Outward and Visible Signs," of Paroid Roofing, may be seen illustrations of the U. S. Government Buildings at Havana, Cuba, where 12,000 squares of Paroid were used in 1898, while in 1902 the Government ordered, at one time, twenty-two carloads of Paroid for shipment to the Philippines; together with other Government buildings at Fort Meyer, Va., Chickamauga Park, Ga., and Pt. Jupiter, Fla., the Delaware & Hudson Railroad shops at Oneonta, N. Y., and the Coal Sheds of the Michigan Central Railroad, Chicago, Ill., the Boston & Maine R. R. Freight Sheds at Rotterdam Jc., N. Y., as well as manufacturing plants, lumber yards, dwellings, and buildings of every description, and from almost every section of the country, showing the adaptability of Paroid to every case. An eloquent testimonial to its fire resisting qualities may be found in the illustration of L. B. Nauss' Lumber Yard, Gloucester, Mass., where sparks had no effect upon this well known roofing. Deserving of honorable mention, too, are the 1,000 squares of Paroid used on the buildings of a Cement Plant, Barcelona, Spain, as well as large shipments to Australia, New Zealand, and South Africa.

The Peerless Spiral Piston and Valve Rod Packing

It will hold 400 lbs. of steam

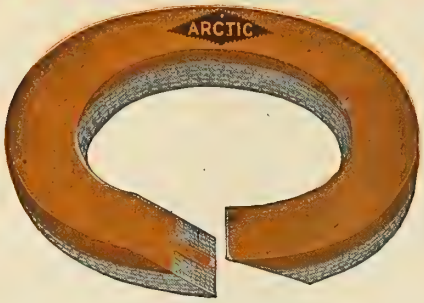
Once tried always used



Will run twelve months in high speed engines

Arctic Packing

To be used exclusively for packing Ammonia Pumps



This packing is made in several hundred sizes

This packing is specially constructed for ice machine service, of layers of rubber and plies of duck which are so arranged and laid as to best resist the actions of ammonia, cold and heat.

The duck is a specially made duck, frictioned with an entirely new compound heretofore unknown to the rubber trade, and the core and back is of the celebrated Rainbow Packing compound, which is specially adapted to resist ammonia, cold and heat.

This packing is constructed on a strictly scientific basis, and the results obtained thus far have demonstrated fully its value for ammonia packing.

This packing is made in several hundred sizes. The rings may be slipped onto the rod very readily.

The usual rule is to be observed in giving measurements, the depth and width of stuffing box and size of piston rod, in order to get the size desired.

Sole Manufacturers of the

Celebrated Rainbow, Eclipse Sectional Rainbow Gasket, Hercules Combination and Honest John Packings.

MANUFACTURED, PATENTED AND COPYRIGHTED EXCLUSIVELY BY

THE PEERLESS RUBBER MANUFACTURING COMPANY

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TRADE PUBLICATIONS.

Yacht and launch owners, and others who are interested in the subject of a compact lighting device, either for boats or small isolated plants, will find much to interest them in an 8-page folder, issued by the Richardson Engineering Company, 36 Pearl street, Hartford, Conn.

The Niles-Bement-Pond Company, 136 Liberty street, New York city, has issued a 750-page catalogue describing machine tools. This book is handsomely bound in red cloth. It contains over seven hundred illustrations, and is one of the handsomest and most complete machine-tool catalogues issued. The volume opens with six full-page illustrations, showing the various works of the Niles-Bement-Pond Company, and following these are thirteen pages illustrating medals and diplomas which have been awarded the various constituent companies of this concern These medals date back as far as 1871, but the great majority are those awarded by more recent expositions. After the medals, the main part of the catalogue begins. First are the machines for railroad shop use. These include a complete line of driving-wheel lathes. Fourteen full-page illustrations are given, showing all sizes from the 51-inch to the 100-inch swing, and one or two special machines, adapted particularly to the use of modern high-power tool steels. The other railroad tools include three styles of cart-wheel lathes, a large variety of axle lathes, cutting off and centering machines, quartering machines, cart-wheel borers and hydrostatic wheel pressers. The next division of the catalogue is devoted to lathes, including all sizes from the Pratt & Whitney bench lathe to the massive Bement 125-inch crank shaft lathe. Besides the standard lathes, a number of special lathes, including pulley lathes, turret lathes and automatic screw machines, are shown. Fifty pages are devoted to planing machines, and a large variety of heavy planers are shown. Various methods of driving by magnetic clutches and motors mounted on the top of housings are illustrated. The large portable rotary planers are among the most interesting machines described in this section of the catalogue. These machines are self-contained, the motor being mounted on the saddle. The largest has a swing of 120 inches, and is arranged so that it can be lifted by a crane and placed in any position on a floor plate. Slotting machines and milling machines take a large number of pages, several very handsome full-page illustrations being devoted to work done on the Pratt & Whitney thread milling machine. A large number of heavy drills are shown, including vertical drills, radial drills and multiple drills. Among the most interesting pages in the catalogue are those devoted to boring machines. First are the horizontal boring machines, which include all varieties of boring machines in which the work remains stationary, the cutting being done by revolving cutters. A complete line of floor boring machines or horizontal boring, drilling and milling machines is shown. Fifty pages are devoted to boring and turning mills. Following the section on boring and turning mills are a few pages devoted to miscellaneous machine tools, and then comes a complete line of boiler-shop machinery, including plate planers, bending rolls, punching and shearing machines, hydraulic presses, steam and hydraulic riveters. In the latter part of the catalogue the full line of Bement steam hammers is illustrated, together with a number of installations of Niles electric traveling cranes. The last pages are devoted to the small tools made by the Pratt & Whitney Company. In the arrangement of the catalogue, particular care has been taken to put the various machines in their logical order, so that any machine can be found without reference either to the table of contents in the front of the book or the index at the back. Metric as well as English dimensions are given throughout, and code-words are placed under each machine While the catalogue is not intended for general distribution, it will be sent to users of heavy machine tools who mention Marine Engineering.

When writing to advertisers please refer to MARINE ENGINEERING.

River navigation is the subject of an illustrated pamphlet of 32 pages, issued by the Marine Iron Works, Station A, Chicago, Ill. Readers of MARINE ENGINEERING who are interested in small and medium-sized craft and powerful steamboats for river service will receive the pamphlet free upon application.

Gas engine troubles are ascribed by the Rochester Gas Engine Company, Rochester, N. Y., principally to the manufacturers who turn out a machine so complicated by "valves and other contrivances without names and too numerous to mention" that it requires the constant services of an expert machinist to keep the engine in running order. A pamphlet sent out by this company states that it has combined in its engines superiority of design, excellence of construction and simplicity and reliability of operation. The Rochester engines are of the two-cycle type. Illustrations and detailed descriptions of the engine and their appurtenances appear in the pamphlet.

Adjustable pocket wrenches for launches and shops, manufactured by the Billings & Spencer Company, Hartford, Conn., and sold by the Charles A. Strelinger Company, Bates street, Detroit, Mich., are the subject of an illustrated booklet, copies of which can be had from either company. Twelve styles of wrenches are described, and each is especially designed for a particular purpose. Users of gas engines of every variety should find these wrenches a great convenience. For some of the wrenches a pipe wrench attachment is provided. The booklet states that in addition to the wrenches described therein, the company manufactures a complete line of drop forged standard engine and machine wrenches, angle-end wrenches, double-end S wrenches, straight, single and double-end wrenches, special machine wrenches, single and double-end tool post wrenches, steel pin wrenches and chuck and spanner wrenches, etc. Special wrenches also are made to order.

"Motor Facts" is the title of an illustrated pamphlet issued by the Bridgeport Motor Company, Bridgeport, Conn. It contains a full description and price lists of the Bridgeport motors, which are built on the two-cycle compression principle, and which, it is stated, differ from the ordinary non-compression type, in that they are compression engines with enclosed crank chambers. It is claimed that Bridgeport motors are symmetrical, neat and compact; that they are simple in design, the parts readily accessible, the ignition positive; that the engine runs quietly, is durable and economical of fuel. The question of lubrication has received special attention, as also has that of ignition. It is claimed that these motors can be regulated to run at various speeds with absolute regularity. The pamphlet describes at length the construction of the Bridgeport motors, and the points wherein it differs from gas engines of other makes. The company also makes launches and deals in yachting specialties of all kinds. This pamphlet, together with a book of testimonials, will be sent free upon application.

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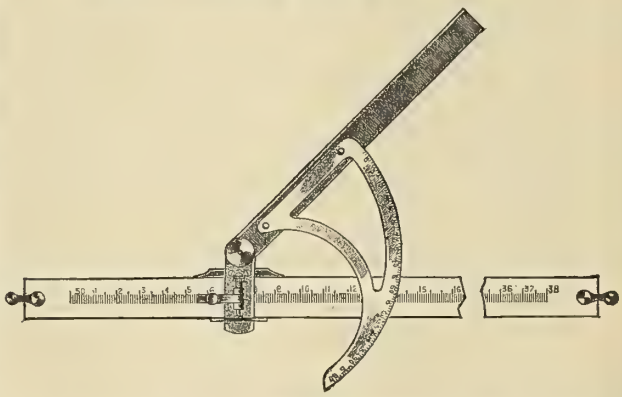

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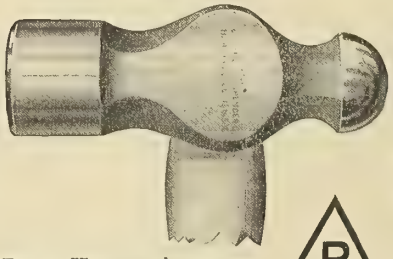

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Electric heating specialties are the subject of a very complete catalogue issued by the Simplex Electric Heating Company, Cambridge, Mass. There are eighty pages, fully illustrated, and listing almost every form of cooking utensil; also a large variety of other appliances, such as glue pots, soldering irons, curling iron heaters, heating pads, instrument sterilizers, radiators, foot warmers, laundry and tailors' irons A catalogue will be sent to readers of MARINE ENGINEERING upon application.

The marine specialties of John Brown & Company, Ltd., Atlas Works, Sheffield, England, are thoroughly illustrated and described in a handsomely illustrated cloth-bound book, copies of which can be had through the New York office, 22 Thames street, from W. C. Wallace, manager of the American branch. The book comprises 62 pages, and gives especial attention to the company's patent marine furnaces, with large drawings showing design, etc., together with a table of working pressures. The Serve patent-ribbed boiler tubes are equally well illustrated and described. Other specialties are the Van Ollefen's patent gear for controlling the doors of water-tight bulkheads, the Ellis & Eaves system of induced draft, which is described with great completeness. Several pages are devoted to illustrations of different types of marine forgings manufactured by this company, either built up or solid forged.

Users of files among our readers may have sent to them free, upon application, a booklet entitled "File Filosophy," issued by the Nicholson File Company, Providence, R. I.

The Economical Burning of Coal Without Smoke, with especial reference to the use of washed coal, by A. Bement, is published for private circulation by the Peabody Coal Company, Chicago, Ill. This is a booklet of forty-eight pages, divided into five chapters, dealing respectively with heat efficiency, incomplete combustion, smoke and its prevention, washed coal and its preparation, and manipulation of fires and furnaces.

Northern marine generators, spherical generators, generators for lighting service, for pumping service and for attachment to grinding machines, are illustrated and described in a series of folders distributed by the Northern Electrical Manufacturing Company, Madison, Wis. Engineers and manufacturers contemplating the use of generating sets should not fail to write for copies of these folders, as well as for Bulletin No. 35, describing multipolar motors. The illustrations and descriptions of Northern motors in machine tool work are especially good.

Sheet metal boats, stamped and embossed, are described and illustrated with many half-tone engravings in a pamphlet issued by W. H. Mullins, Salem, Ohio. The pamphlet states that these boats are built for business or for pleasure—for hunting, fishing, canoeing; that they are made of steel, do not rust, wear out or leak, and do not sink. It is said that they have few joints, are built in plates like warships, and that instead of being clinker-built they are carvel-built; that it is impossible for them to break or buckle on account of their construction, and that they weigh no more than clinker-built wooden boats. All boats are made with air chambers, which it is claimed will float them, even when overturned. Price lists and testimonials are included. A copy of the pamphlet will be sent free to readers of MARINE ENGINEERING upon application.

Marine gas engines, of the single-cylinder, two-cycle type, are described in an illustrated pamphlet sent out by the Eagle Bicycle Manufacturing Company, Torrington, Conn. It is claimed for the Eagle engines that their speed can be instantly regulated, and that the engine will run steadily at all speeds. The speed is controlled by new and simple devices, which, it is stated, gives an instantaneous and wide range in time of spark ignition, with relation to the position of the piston. The company states that it uses a throttle valve by which the amount of gas admitted to the explosion chamber can be accurately regulated. By means of clever devices the engines may be started with ease, obviating any sudden or accidental reversing of the flywheel, with possible injury to the operator. The flywheel is easily removable from the shaft without the use of special tools. Readers of this magazine will receive the pamphlet free upon request.

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Compressed air installations is the subject of a booklet issued by the American Air Compressor Works, 26 Cortlandt street, New York city. The pamphlet illustrates what are said to be new types of American self-contained poppet air valves, intercoolers, unloading governors and American air compressors. The booklet and a complete catalogue will be forwarded upon application.

Skiffs and canoes, are the subject of a catalogue issued by Wilbur & Wheelock, Clayton, N. Y., who announce that they use the best material obtainable for the construction of their boats; that they do their own work, and test every boat before shipping. Illustrations are given showing skiffs and canoes of various types and sizes. The firm also makes oars, paddles and other boating appurtenances.

A motor boat trip from New York to the St. Louis Fair is discussed in No. 6 of *The Propellor,* issued by the Lozier Motor Company, 1 Broadway, New York city. A variety of routes are given, with illustrations of the scenery. The company asks that parties contemplating this trip send a synopsis of the proposed route, together with information as to the speed of the boat, etc. The pamphlet describes in addition the latest types of Lozier motor boats.

Keystone motors, single and double cylinder, are described in a folder issued by the Delaware River Motor Company, Harrison Building, Philadelphia, Pa. It is stated that the 1904 model has many improvements. Both inlet and exhaust ports are opened and closed by the piston. Shaft bearings are provided with stuffing nuts, to prevent loss of compression in the crank case, even when the bearings are considerably worn. Cylinders and cylinder heads are water-jacketed Speed is controlled by throttle or spark. Either the jump spark or the make-and-break systems are used.

The machinery catalogue issued by the Scully Steel and Iron Company, Chicago, Ill., is a handsomely-bound volume of 150 pages, with 147 illustrations. Machine tools of all sorts are fully described and illustrated. Among these of interest to ship and engine builders are air compressors, forges, pneumatic hammers, steam hammers, lifting jacks, plate-bending rolls, pneumatic tools, punches and shears and riveters. The illustrations are particularly good, and the descriptions accompanying them are concise but complete. The company states that its tools and machinery are carefully designed with a view of adaptation to the work for which they are intended, and that they are the result of long experience and investigation.

The Springfield Boiler and Manufacturing Company, Springfield, Ill., is mailing an illustrated catalogue describing corrugated furnaces, boilers, stand pipes, steel pipe tanks, hydraulic dredges, water jackets and other iron and steel work. The catalogue states that since the last one was issued the plant has been completely remodeled and rebuilt. This company does not carry boilers in stock, but makes them to order. Many pages of tables and specifications appear, and much useful information is given, such as tables showing the number of gallons in tanks of various sizes, the pressure of water per square inch for every foot in height up to 300 feet, and the Hartford Steam Boiler and Inspection Company's rules for the management and care of boilers.

The "Ideal" Self-feed Tube Cutter is the subject of an illustrated folder issued by the Scully Steel and Iron Company, 136 Fulton street, Chicago, Ill. It is stated that by means of this device tubes can be cut off either inside or outside of the boiler head. The tool is turned by means of a ratchet The feed handle is swiveled, in order to get close to the boiler shell. All tubes, it is claimed, are cut off the same distance from the head, and are cut with a bevel ready for beading. An extension is made for attachment to the cutter, and when this is used it is stated that a man can stand upright outside of a boiler and cut off the tubes either inside or without the head, enabling him to do four times as much work as when crouched up inside of a smoke-box, chipping off the tubes.

A NEW BOOK

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By J. W. Kellogg,
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The third chapter gives a thorough treatment of wiring and insulation, considers the advisability of installing steam turbine, advises as to distribution of current, and proper size of the mains. In further sections the single and double-wire circuits as installed in English and American ships, and the desirability of the third-wire circuit are considered The last paragraph takes up the requisite sizes and location of the distributing wires.

Chapter IV. is devoted to electric fixtures, fittings, joints, ducts, insulation, and other minor details which, however, are of the utmost importance for the successful operation of a plant. Many illustrations are given of these details as on the market.

Chapter V. Electricity is being used more and more every day for running auxiliaries and chapter five is devoted to a sketch of what is the most recent practice in this line. The use of the electric storage battery on board ship is also considered.

In Chapter VI. is taken up a specific case of wiring for a small steamer. The lay-out of the mains is considered and the reason given for final arrangement. Full details of sizes, number of lights on each circuit, and location of them are stated. For this chapter two large drawings illustrate the wiring plan at the dynamo, and the location of the distributing panels on board the ship.

An Appendix contains chapters VII and VIII.

Chapter VII. comprises detail drawings and description of a lighting plant for launches, consisting of a generator belted to the fly-wheel of the gasoline propelling engine used in combination with a storage battery.

Chapter VIII. is devoted to isolated plants with generator direct-conneted or belted to a gasoline engine, for lighting sailing yachts, large launches, etc.

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If you have ever taken a railroad trip you will enjoy the "Story of Phoebe Snow," which describes in a series of dainty pictures the experiences of a pretty girl who went to Buffalo. The illustrations are in seven colors, each reproducing a design of the girl in white which the Lackawanna Railroad has made so familiar in the last few months. The booklet has a particularly pleasing cover and will afford considerable amusement beside giving information which every traveler ought to know. It will be sent in response to request, accompanied by two cents in stamps, to T. W. Lee, General Passenger Agent, New York City.

The Edson Manufacturing Company, 255 Atlantic avenue, Boston, Mass., is distributing a mailing card, calling attention to yacht steering gears and appliances, hydraulic pile sinking outfits, prospecting and mining outfits and other machinery manufactured by the company.

Two-cycle vs. four-cycle motors is the subject of a discussion in Catalogue E, issued by C. L. Barker, Norwalk, Conn., a copy of which will be forwarded upon request. A description is given of the construction and design of the Barker marine motors with their appurtenances.

Fire brick, vitrified paving brick and fire proofing materials are the subject of a catalogue issued by the National Pyrogranit Company, 17 Battery Place, New York city. Numerous tables are given showing the number of wedge brick, key brick, arch brick and bricks of many sizes, for various circles.

Two-cycle marine engines are illustrated and described in a brochure issued by Termat & Monahan, Oshkosh, Wis. A photograph is given of the speed launch *Merlie,* winner of the Oshkosh Yacht Club cup, and equipped with a Termat & Monahan 12-horse-power, four-cycle engine. A circular describing four-cycle engines is also issued by this firm.

An illustrated placard, issued by John F. Allen, 370-372 Gerard evenue, New York, N. Y., will be found of interest by users of riveting machines. It presents some statements regarding the results accomplished by the "Allen" Portable Pneumatic Riveter that are worth noting.

The noted electrical engineer, André E. Blondel, is the subject of the latest monthly card calendar issued by the Bullock Electric Manufacturing Company, Cincinnati, Ohio. A portrait of Mr. Blondel appears on the front of the card, and on the reverse is a short sketch of his life and achievements. The Bullock card calendars are all lithographed in several colors.

BUSINESS NOTES.

THE AMERICAN BUREAU OF SHIPPING, 66 Beaver street, New York city, reports the following vessels classed and rated: American screw *Shawmut,* American schooners *Frontenac, Magnus Manson, Claremont, Anthony D. Nichols* and American three-masted schooner *Carrie A. Norton.*

NICHOLSON LOGS.—Several ships are being fitted at present with the Perfected Ship Log, made by the Nicholson Ship Log Company, 204 Superior street, Cleveland, Ohio. Among these vessels are the cable steamer *Minia,* for the Anglo-American Telegraph Company; the steam yachts *Warrior,* belonging to Mr. Frederick W. Vanderbilt; the *Rambler,* belonging to A. Cass Ledyard; the *Tarantula,* W. K. Vanderbilt, Jr., and the Great Lakes steamers *Northwest* and *Northland* and *City of Benton Harbor.* There are many inquiries for this log, and several other orders are expected to be closed.

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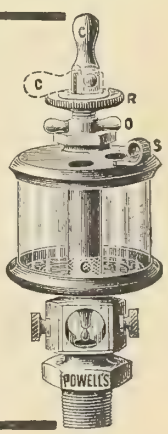

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C. J. RAINEAR & CO., 518 Arch Street

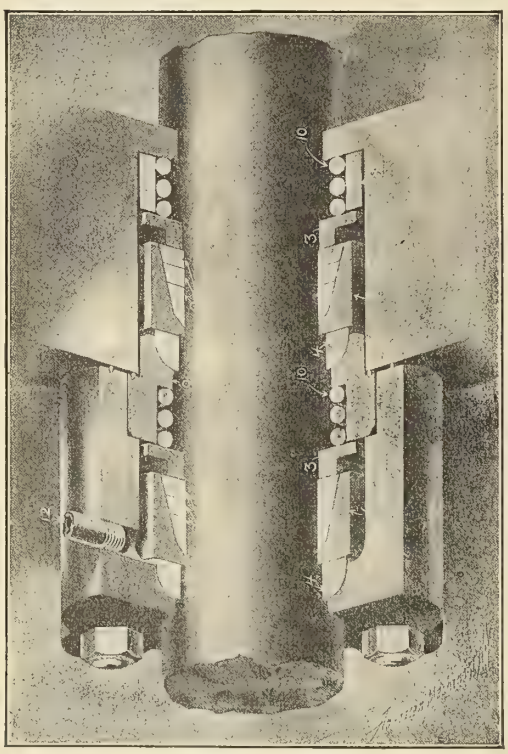
Oil for Gas Engine Lubrication.—The A. W. Harris Oil Company, Providence, R. I., issues a circular, in which it is stated that for fifteen years it has been experimenting with and manufacturing lubricants for gas engines, until now it has perfected lubricants which fulfill all requirements of the various types of motors. Special brands are made for the lubrication of motors using the water-cooled, air-cooled or splash systems, as well as for engines using either saturated or superheated steam. Regarding the oil for watercooled motors, the company states that it affords the necessary lubrication, yet leaves no deposit, and does not carbonize in the cylinder, and, moreover, does not congeal in low temperatures. The oil for air-cooled machines is heavier, and is a high fire test oil. This oil is also recommended for the splash system of lubrication. Regarding the superheated steam cylinder oil, it is claimed that it will stand a temperature of over 700 degrees.

Will Exhibit at St. Louis.—The Northern Electrical Manufacturing Company, Madison, Wis., states that it will have an extensive exhibition at the World's Fair, which it is planned to make a Mecca for people interested in electrical machinery, as well as for those who are interested in the subject of motor-driven machines and machine tools. The location of the exhibit is Section 14, Palace of Electricity.

Rochester Gas Engines.—The Rochester Gas Engine Company takes pleasure in announcing that it has reorganized, with J. S. Graham, president; J. J. Leary, vice-president, and W. J. Graham, secretary and treasurer. Messrs. J. S. and W. J. Graham have been manufacturers of machinery in Rochester, N. Y., for many years. Increased facilities for the building of marine, stationary and automobile engines in large quantities have been completed.

United States Metallic Packing

owes its great success to its flexibility, and to the fact that all packings are designed to suit the especial work for which they are required.



Class No. 1 Packing.

As wear takes place, our packings are automatically adjusted by the steam pressure itself.

Their flexibility is such that no matter how badly an engine is out of line, or how much play there is between cross-heads and guides, or between piston and cylinder, the packings float with the rods, and hot rods are avoided.

All rings are in halves so that it is not necessary to disconnect the engine when making repairs or renewals.

OUR PACKINGS RUN FOR YEARS WITHOUT ATTENTION

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Bleaching, Dyeing, Drying, and Finishing Machinery, and Improved Hot-Water Remover for Clearing, Drying Cylinders, and Heating Systems of Condensed Water and Air, and Returning Water to Boiler.

NEW YORK OFFICE, 39 CORTLANDT STREET.

Marine Paints.—James H. Tarr, Gloucester, Mass., manufacturer of marine paints, states that his products are largely used not only by vessel owners, but also in drydocks and repair yards, and that he makes several different compositions, each of which is especially adapted to some particular class of vessel.

The C. O. Bartlett and Snow Company, Cleveland, Ohio, reports orders for conveying machinery from the following companies: The Iroquois Portland Cement Company, Caledonia, N. Y.; the Elk Rapids Portland Cement Company, Elk Rapids, Mich.; the Grasselli Chemical Company, Cleveland, Ohio; the Struthers Furnace Company, Struthers, Ohio; the Sandusky Portland Cement Company, Sandusky, Ohio; the Sherwin-Williams Company, Cleveland, Ohio; the Cleveland Gas, Light and Coke Company, Cleveland, Ohio; the Farmers' Chemical Company, Cleveland, Ohio; and the S. Lorain Coal Company, Lorain, Ohio; also from the Rossland Power Company, Rossland, B. C., for mining machinery.

John McCormack, Contracting Engineer, 52 Broadway, New York city, announces that he is prepared to furnish drawings and specifications and to contract for equipping marine and land internal furnace boilers, horizontal and vertical tubular boilers, locomotive boilers, all kinds of steel construction work, complete power plants, mechanical stokers, etc.

Doubles Its Capital Stock.—A doubling of its capital stock, which has been $1,000,000, is announced by Crocker-Wheeler Company, manufacturers and electrical engineers, Ampere, N. J. This company was organized in 1892 by Dr. Schuyler Skaats Wheeler and Prof. Francis B. Crocker, on a relatively modest basis. It now has fifteen branch offices, from Boston to San Francisco, and does one of the largest businesses in the world in electric power apparatus. The capitalization was several times increased, until in 1899 it had become $1,000,000. In view of the rapidly expanding business the stockholders have now decided to increase this amount to $2,000,000.

A New Fireproofing Material, known as "Ceilinite," has been placed on the market by the H. W. Johns-Manville Co., 100 William street, New York city. It is designed especially for fireproofing the ceilings in electrical cars, for which purpose it is being used by the Pennsylvania Railroad Company and the Interborough Rapid Transit Company. "Ceilinite" may be used for lining partitions, ceilings, side walls and at every point where a flexible fireproof barrier is required, as well as for various other purposes. It is made from specially prepared asbestos, in pieces ⅛ inch to ⅜ inch thick, 36 inches wide and about 50 feet long. Samples and prices may be obtained from the manufacturer's offices in New York, Milwaukee, Chicago, St. Louis, Boston, Philadelphia, Pittsburg, Cleveland, New Orleans and London.

The Organization of Industrial Departments by several of the eastern trunk lines during the past two years illustrates one of the modern business methods of railroad corporations. Beginning with the Delaware, Lackawanna and Western Railroad Company, New York, N. Y., the first to organize such a department among the trunk line group, this idea of promoting the location of desirable industries has become an important feature of railroad management. With the Lackawanna this industrial promotion is carried on along the most progressive lines. For instance, among other factory properties, C. W. Ten Broeck, the industrial agent of the Lackawanna, is just now interested in securing the re-occupation of a vacant power plant at Scranton, Pa. The property approximates 17,630 square feet of floor space and includes machine and storage shops, office and pattern shops, engine room, boiler room, etc., all of which is served by a Lackawanna side track. The road is naturally anxious to see such properties running at full capacity and in conducting a department whose business it is to accomplish such work, the Lackawanna being alive to the benefit to be derived therefrom.

PAINT A SHIP with white lead or any other white except

ZINC WHITE

And you will have a shabby-looking ship at the beginning of her first voyage. Paint with *Zinc White*, and she will remain "ship-shape" through several voyages.

FREE: Our Practical Pamphlets:
"The Paint Question,"
"Paints in Architecture,"
"Specifications for Architects,"
"French Government Decrees."

THE NEW JERSEY ZINC CO.

71 Broadway, New York

We do not grind zinc in oil. Send for list of zinc paint manufacturers.

The Hall Manufacturing Company has removed from 40 Cortlandt street to 62 Cliff street, New York city, where it has taken larger offices.

Samuel J. Williams, manufacturer of marine specialties and copper paints, has removed from 11 Broadway to the Maritime Exchange Building, 78 Broad street, New York city.

The Maxfield-Francke Company, manufacturers of the Francke four-ported engine has removed from 120 Liberty street to the Electrical Exchange Building, 136 Liberty street, New York city.

George N. Gardiner & Son, manufacturers of the American McInnes anti-corrosive and anti-fouling compositions, who have been more than thirty years at 53 South street, have removed to 15 William street, New York city.

Stilwell-Bierce and Smith-Vaile Company has removed from 141 Broadway and has taken the ground floor, 93 Liberty street, New York city, where it will carry a full line of marine and stationary pumping machinery Mr. George W. Neff remains in charge as General Eastern Manager.

Alfred B. Sands & Son, yacht plumbers and manufacturers of yacht plumbing specialties, who for many years have been located at 134 Beekman street, have removed to 242 Water street, New York city, where they have a larger building and better facilities for handling their increased business.

The Emperor of Germany has ordered from the Edson Manufacturing Company, 255 Atlantic avenue, Boston, Mass., a steering gear for his new yacht now building. The wheel and steering gear of the Emperor's yacht Meteor were built by the Edson Manufacturing Company.

Repairs to an Engine Frame.—The Pennsylvania Railroad Company has written the Goldschmidt Thermit Company, Wall Street Exchange Building, New York city, that an engine, the frame of which was repaired by the thermit welding process, on February 20, has been on the road ever since. The thermit used for this welding had in it a mixture of 2 per cent. pure manganese, free from carbon, and 5 per cent. of iron punchings.

Hollow Staybolts in Japan.—The Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, reports several large orders from Japan for double refined charcoal iron hollow staybolt bars. The company states that its trade with the railway companies and boiler manufacturers of Japan, and also with the Japanese government, is rapidly increasing. The company reports very gratifying results of an inspection of its staybolts by the United States steamboat inspection service.

Jump-spark Coil and Spark-plug.—This device is made by the American Coil Company, West Somerville, Mass. The coil and plug are made in one piece, ready to put on the engine without the usual wiring, as there is only one wire running from the coil case, and this is an ordinary primary wire running direct to the battery, and on which water has no effect. It is stated that the combination is water proof, and thus does away with the usual troubles where the jump-spark is used in damp places. A full description and catalogue will be sent upon application to readers of Marine Engineering.

War Department Orders 120 Boats.—The Electric Launch Company, Bayonne, N. J., has received an order from the United States War Department for 120 boats, to be used as tenders to the submarine craft now building. The order was obtained by the builders under competitive bidding, and the boats are to be completed before July 1. This company states that it is also building a large number of electric and gasoline launches and yachts. One built for use on Lake George will be charged from the electric light plant in its owner's summer residence, and by a special arrangement the residence can be lighted by the electricity in the launch if the electric plant is not running.

"Throw Away Your Glue Pot"

WHY have the smell of boiling glue around you all day, and the waste and expense of boiling dry glue, when you can for less money use

ARMY AND NAVY LIQUID GLUE?

NOT A FISH GLUE but a pure hide and sinew glue in liquid form.

THE GLUE OF THE 20TH CENTURY

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" 2, Wm. Kelly, 11 Wall St., Cleveland, O.
" 3, A. L. Jones, 289 Champlain St., Detroit, Mich.
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" 5, Otto Boettger, 1035 E. Hopkins Ave., Baltimore, Md.
" 6, Wm. Arste, 322 Pine St., St. Louis, Mo.
" 7, Wm. T. McElwee, Box 1556, Portland, Me.
" 9, Wm. Bridges, 784 1-2 12th St., Milwaukee, Wis.
" 13, John G. Paulding, 1746 Tulip St., Philadelphia, Pa.
" 14, Joseph F. Dumas, 403 Dauphin St., Mobile, Ala.
" 15, R. C. Skinner, 622 Louisa St., New Orleans.
" 17, Jas. D. Robinson, 341 Isabella St., Newport, Ky.
" 18, Wm. Hurst, 715 Walnut St., Cairo, Ill.
" 20, Jos. B. Barry, 206 Keel St., Memphis, Tenn.
" 21, Lawrence Miller, 304 E. Jackson St., Vicksburg, Miss.
" 23, Wm. R. Lewis, 213 E. Front St., Jeffersonville, Ind.
" 24, Jas. B. Flach, 327 N. 4th St., Paducah, Ky.
" 26, T. H. Kirkbride, 910 E. Columbia St., Evansville, Ind.
" 27, L. C. Schwall, 598 S. Madison St., Bay City, Mich.
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" 33, James J. Waters, 283 Hudson St., New York, N. Y.
" 35, William M. Coombs, 36 East St., San Francisco, Cal.
" 36, Jos. Thomas, 57 Sea St., New Haven, Conn.
" 37, John B. Bender, 1215 Evesham Ave., Toledo, Ohio.
" 38, Chas. S. Follett, 73 Starr Boyd Bldg., Seattle, Wash.
" 39, Frank Feeney, 513 E. 8th St., Erie, Pa.
" 40, Chas. Drouet, 1003 Ave. I, Galveston, Tex.
" 41, W. H. Marshall, 343 Holladay St., Portland, Ore.
" 42, Jas. Manning, 802 E. Duval St., Jacksonville, Fla.
" 43, Thomas J. Coyle, 627 Superior St., Port Huron, Mich.
" 44, Chas. J. Sullivan, 489 1st St., Manistee, Mich.
" 45, W. L. Salter, Care O. S. S. Co., Savannah, Ga.
" 46, D. W. Farrell, Clayton, N. Y.
" 47, J. R. Cook, Sault Ste. Marie, Mich.
" 48, Alfred Hegemer, 140 E. Park St., Sandusky, O.
" 51, H. S. Connell, 12 Ransom St., Muskegon, Mich.
" 53, Harry Stone, Box 445, Marine City, Mich.
" 55, Archie Stalker, Box 883, Cheboygan, Mich.
" 57, E. B. Meeker, 71 Abeel St., Kingston, N. Y.
" 58, E. Capers Haselden, Box 31, Georgetown, S. C.
" 59, Geo. F. Keating, 74 Webster St., E. Boston, Mass.
" 62, N. S. Lawrence, 30 Connecticut Ave., New London, Conn.
" 63, M. J. Burke, 152 Sheridan Ave., Albany, N. Y.
" 65, W. C. Palmer, Care Consumers' Coal Co., Charleston, S.C.
" 67, James K. Dole, Saugatuck, Mich.
" 70, Chas. T. Smith, 665 Commercial St., Astoria, Ore.
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" 73, E. M. Donahue, 1308 Cherry St., Green Bay, Wis.
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" 76, Orson Vanderhoef, Grand Haven, Mich.
" 77, John P. Hall, 1215 Huron St., Manitowoc, Wis.
" 78, J. P. Burg, 2722 Minnesota Ave., Duluth, Minn.
" 80, Edward S. Welch, 338 Hamilton St., Albany, N. Y.
" 81, Jas. L. Sweeney, 206 E. Sarragosa St., Pensacola, Fla.
" 82, Fred H. Gowell, 427 Middle St., Bath, Me.
" 85, John A. Packard, 623 Merchant St., Alpena, Mich.
" 86, Sherman A. Smith, 737 Menekaunee Ave., Marinetta, Wis.
" 87, Geo. B. Milne, 809 Fourth St., Detroit, Mich.
" 88, C. O. Chapman, S. B. Canal, Sturgeon Bay, Wis.
" 89, Geo. E. Willard, 4 Isabella St., Ogdensburg, N. Y.
" 91, A. L. McLaren, 130 W. Walnnt St., Ashtabula, O.
" 92, Jos. D. Budd, Box 50, Sta. I, Saginaw, W. S., Mich.
" 93, W. J. Cook, 2220 G. St., N. W., Washington, D. C.
" 94, Geo. R. Jones, Box 222, Washington, N. C.
" 95, P. J. McMahon, Box 199, Key West, Fla.
" 98, Bert Hamlin, 114 Exchange Place, New Orleans, La.
" 100, Jas. P. Lynch, Honolulu, H. I.
" 101, J. K. Cotton, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., South Haven, Mich.
" 103, A. E. Pittman, Box 378, New Bern, N. C.

TRADE PUBLICATIONS.

Induction coils, for battery or generator devices, are the subject of a mailing card sent out by the Induction Coil Company, Milwaukee, Wis. Information will be furnished upon application and enquirers are requested to state whether the coils are wanted for batteries or for generators.

Flexible transmission of power for boat-building machinery, electric hammers, drills, bridge construction, etc., is the subject of Bulletin No. 17, issued by the Coates Clipper Manufacturing Company, Worcester, Mass. The bulletin states, "a flexible shaft is no new thing, but a hardened steel ball-bearing flexible shaft is new indeed. In the new Coates shaft a transmission of 75 horse power has been developed, and the shaft, owing to its ball and socket link construction, is extremely flexible." This flexible shaft is made up of a series of hardened steel joints, shaped like a ball, which, it is said, allow a high rate of speed without heat, and, if broken, a new shell can be inserted and the shaft will be as strong as ever and just as flexible. The Coates shaft is claimed to work equally well in either direction. Drill presses, die sinker's engine, multipliers, breast drills, center grinders, boring machines, and other tools suitable for attachment to the Coates shaft, are also illustrated and described.

The marine gas engines manufactured by Lacy Brothers, Toledo, Ohio, are described in a handsomely illustrated catalogue which the firm is distributing. The Lacy engines are built in many sizes in both the two-cycle and the four-cycle type. Each type, the pamphlet states, has its advantages, dependent upon the service for which it is to be used. All bearings are made of phosphor bronze as are also the connecting rods of the smaller engines. Crank shafts are of forged steel. Great care has been taken in the construction of the vaporizer, throttle valve, and muffler. The engine cylinder is water jacketed, and it is claimed that there is no place on the exhaust pipe where the hand may not be placed with comfort. The Lacy engines use the jump-spark method of ignition. Many of the two- and three-cylinder engines are sent out without reversing gears or reversible propellers. In this case a friction clutch coupling is furnished, enabling the operator to stop, start, and reverse the engine with the propeller disconnected. The starting of the Lacy engine is claimed to be very easy, and great care has been taken to produce proper balancing and absence of vibration. The four-cycle engines are designed for working boats, tugs, and large yachts. This firm also furnishes launches of various types.

Marine gasoline engines of the two-cycle type are described and illustrated in a catalogue issued by the Michigan Motor Company, Grand Rapids, Mich. The catalogue states that owing to improvements in design the engine uses less than one gallon per brake horse power on a ten-hour run, or less than one-tenth of a gallon per hour. The company claims that it has given great care and attention to securing for its engine lightness, compactness, durability, and simplicity of design. The engine is said to be made of the finest gray iron mixed with steel to insure strength. The cylinders and cylinder heads are tested by hydraulic pressure, the pistons are long and ground fitted. Crank-shaft bearings, connecting rod, and piston-pin boxes are made of gun-metal bronze. The other wearing parts are of hardened steel. Crank shaft and connecting rods are made from solid forgings of open-hearth steel. The company states that its engine makes no disagreeable noises, and that there is no danger of fire, ignition taking place inside of the cylinder, and that the cylinder, cylinder head, and exhaust pipe, the only parts subject to heat, are water jacketed. Improvements are claimed in the devices for starting and reversing the engine and in other appurtenances. This company also makes reversible propeller wheels and reversible friction clutches.

Modern pumping machinery is the subject of Catalogue No. 3, issued by the Heisler Pumping Engine Company, Westinghouse Building, Pittsburg, Pa. The Heisler boiler feed pump is said to be very powerful and to operate against high pressure with a minimum cost for fuel.

Gas engines of the two-cylinder type are illustrated and described in a catalogue sent out by the Automatic Machine Company, Bridgeport, Conn. The company states that its engine, the "Automatic," is the product of experience and skill; that its special features are simplicity of design, strength of material, and accessibility of parts, thus avoiding the removal of one part in order to reach another. The company supplies engines and machinery for working boats as well as for yachts. The "Automatic" engines are of the four-cycle type. Hoisters, side rollers, oyster dredges, dredge rings, cargo hoists, reversing gears, friction connections, knuckle joints, and other gas engine and boat appurtenances are also described in this catalogue, a copy of which will be sent upon application.

Hand motors for propelling boats are the subject of a folder distributed by the Prouty Manufacturing Company, 35 Oliver street, Boston, Mass. The company states that the use of its hand motors gives greater speed with less labor than when oars are used, and that, unlike other motors, the expense ends with the first cost. The operator, moreover, faces in the direction the boat is going, and can work the motor as readily in rough as in smooth water. A single operator, it is claimed, can make three or four miles an hour. To make five or more miles an hour there should be two persons operating the motor. While the boats manufactured by this company are designed with special reference to the motor, no especial construction is required, it is claimed, except that a sufficient depth of keel should be added to enable the propeller shaft to be located five inches below the water line when the boat is light.

Users of calculating devices will be interested in the Goodchild mathematical chart made by the Keuffel & Esser Company, manufacturers of drawing materials and surveying instruments, 127 Fulton street, New York city. This chart is a single folded sheet on the two inside pages of which is a scale of logarithms upon 100 lines. The lines are graduated, and below every fifth graduation is printed the number represented in the logarithmic scale by that particular line and distance. In multiplication, therefore, the sum of the initial figures and of the distances will give the initial figure of the line on which, and the distance at which, the product will be found. The operation for division is practically the reverse of that for multiplication. Of the two pages not shown in the cut, the first page contains the very simple directions and some examples, and the fourth page contains, on scales of 10 lines, the logarithmic sines and co-sines and numbers for measuring them.

PRACTICAL SHIP BUILDING.

A Treatise on the Structural Design and Building of Modern Steel Vessels. The Work of Construction, from the making of the Raw Material to the Equipped Vessel, including Subsequent Up-keep and Repairs.

By A. CAMPBELL HOLMS, Member of the Institution of Naval Architects and of the Institution of Engineers and Shipbuilders in Scotland: Surveyor to Lloyd's Register of Shipping. 2 Vols. [Vol. I., Text. Medium 8vo. Vol. II., Diagrams and Illustrations. Oblong 4to] $16.00 NET, Expressage extra.

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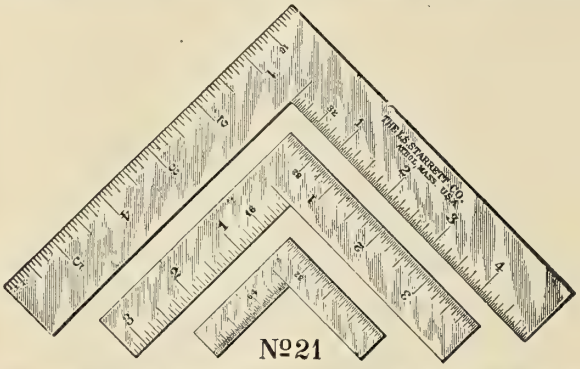
They cost but little more and they can always be depended upon to be accurate if they are **Starrett make.**



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Our CATALOGUE No. 17L, which tells of all the STARRETT TOOLS, Sent FREE

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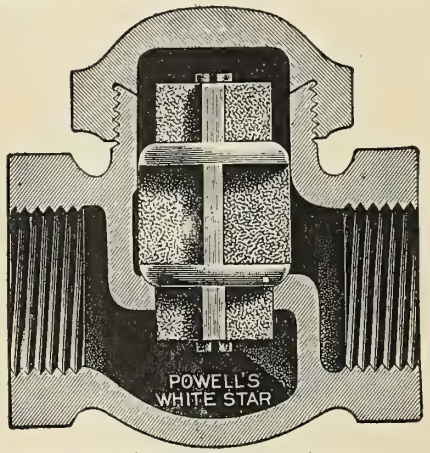
"WHITE STAR" CHECK VALVE

Reversible and Re-Grinding



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Both ends made to gauge.
Economical because reversible and made of best material.
Will withstand a temperature of 2,000 degrees.
Simple and convenient—Re-grinding effected by inserting screw-driver in slot at either end of disk and rotating back and forth.

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carefully discusses the question with particular reference to
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Write for a free copy.
JOSEPH DIXON CRUCIBLE CO.
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Please Mention This Publication.

Charles Proteus Steinmetz is the subject of the latest monthly card biography issued by the Bullock Electric Manufacturing Company, Cincinnati, Ohio.

Lubricators, oil cups, oil pumps, grease cups, multiple oilers, generator valves, and other engineering specialties are illustrated and described in a 46-page catalogue issued by the American Lubricator Company, Detroit, Mich. There are eight different patterns of sight feed lubricators, brass lubricators of two styles, various kinds of oil cups, and, in fact, a great variety of patterns of all the specialties manufactured. No one interested in this line of goods should fail to send for a copy of the catalogue.

Horizontal milling machines, hydraulic punching machines, rotary planers, thread millers, and other machine tools are described and illustrated in *The Progress Reporter*, published by the Niles-Bement-Pond Company, 136 Liberty street, New York city. Among other illustrations is a photograph of a steel worm, 3 7-8 inches in diameter, cut in sixteen minutes on a Pratt & Whitney thread miller. The object of the publication is stated to be to keep the public and the employees of the company informed as to the new machines and devices which are constantly being brought out. All persons desiring to receive copies regularly will be put on the company's mailing list upon request.

Oil rivet forges, spraying machines, torches, sand blasts, heaters, and lead and Babbitt metal furnaces are the subject of a folder entitled "Macleod's Labor Savers," issued by Walter Macleod & Company, 457 East Front street, Cincinnati, Ohio.

Stationary motors for machine shops are described in a folder issued by the Bridgeport Motor Company, Bridgeport, Conn. Marine motors and launches are also mentioned in the same folder, and are fully described and illustrated in other literature which will be sent upon request.

Metal expanding tools and machinery are illustrated and described in a pamphlet entitled "Lovekin Tools," issued by the Scully Steel and Iron Company, Chicago, Ill. It is stated that the tools and machines described are for expanding and flanging pipes from the smallest size boiler tube to the largest lap-welded piping made, and for expanding valve seats in gate, globe, or angle valves. It is claimed that these tools are based on a new mechanical principle, that they are of simple construction and easy to operate. Copies of the pamphlet will be forwarded upon application.

The Mc'Creery cooling, heating, ventilating, cleansing, and humidity-regulating system for ships is handsomely illustrated and concisely described in a catalogue issued by Joseph McCreery & Son, Toledo, Ohio. This system is in use, so the catalogue states, on the Fall River liner *Puritan*, on several United States transports and training ships, on the steamers *Northland, City of Mackinac, City of Cleveland, City of Erie*, and other ships which ply on the Great Lakes, on vessels of the Old Dominion line, and on many other vessels both in the navy and merchant marine. In the boiler and engine rooms of steamships the cooling system is claimed to be invaluable. Delays on account of heat in the engine and boiler rooms of ships are said to be impossible if the McCreery system of cooling is in operation.

Motor boats and gas engines are described in a handsomely illustrated catalogue issued by the Lozier Motor Company, 1 Broadway, New York city. The catalogue describes in much detail the various types of boats manufactured by this company, and numerous handsome illustrations accompany the text, giving an accurate idea of the construction and fittings of the boats, both inside and outside, together with the many yachting appurtenances furnished by the company, such as removable standing roofs, collapsible spray hoods, cabin furniture and fixtures, steering gear, lockers, seats, and cushions. The Lozier Motor Company makes many styles of power boats, such as torpedo-stern boats, "standard" construction boats, cabin boats, launches of various sizes, hunting cabin cruisers, ocean cruisers, and automobile racing boats. The marine gasoline engines manufactured by the company are of the two-cycle and four-cycle types, and are made in sizes ranging from three to forty horse power. A separate catalogue is devoted to these engines.

WATCH THIS SPACE FOR OUR NUMEROUS SPECIALTIES.

WALWORTH MFG. CO. TOOLS and SUPPLIES for STEAM WATER and GAS USERS BOSTON MASS.

SOLE MANUFACTURERS OF THE FOLLOWING:

Stillson Pipe Wrench.
Walworth Die Plates.
Miller's Ratchet Die Plates.
"Ruff and Tuff" Pipe Dies.
Hill's Solid Pipe Dies.
Hall's Brass Pipe Wrench.
Hall's Cast Iron Pipe Cutters.
Stanwood Pipe Cutters.
C. C. Walworth Pipe Cutters.
Stanwood 3 Wheel Pipe Cutters.
Miller's Ratchet Pipe Cutters.
Ashley Right or Left Nipple Holder.
Hall's Patent Pipe Reamers.
Walworth Heavy Vise, 1/8 to 6 in.
Kingfast Pipe Vise, 1/8 to 2 in.
Hall's Tapping Machines for Street Mains
Smith Friction Hand Tools.
Drill Stocks,
Combination Socket Wrench with Drill Auger Bit,
Screw Driver Stock, &c.
Taps, Reamers and Drills.

JOBBERS SELL THEM—IF YOURS DON'T, WRITE.
New York, Park Row Building. **WALWORTH MFG. CO.,** Boston, 128 Federal Street.
Write for our BLUE CATALOGUE "D." showing complete line of engineers' pipe fitting tools.

Vertical boring and turning mills, manufactured by the J. Morton Poole Company, founders and machinists, Wilmington, Del., are described in an illustrated folder issued by that company. The folder declares that the company's boring and turning mills have been designed to meet the demand for stiff, powerful mills capable of making the most efficient use of high-speed tool steels.

The ratchets manufactured by the Armstrong Brothers Tool Company, 617 Austin avenue, Chicago, Ill., are described in a folder the company is sending out. This folder states that the Armstrong universal rachet will drive a drill in any position where it is possible to move the handle either in a verticle or a horizontal direction, or at any intermediate angle. The rachet has no ball joints, bevel gears, or other complicated parts, and it is claimed that for ordinary work the handle can be rigidly fixed almost instantly.

The steam motors manufactured by the Dieter Steam Engine Company, 113 Liberty street, New York city, are described in a folder issued by the company. The claim is made that the motors are compact, simple in construction, economical in use of steam, and of great durability. In place of slide or piston valves, poppet valves are employed. There are no stuffing boxes, and consequently no packing. The motor is lubricated from the crank case. It is claimed that this motor can be instantly reversed when running at full speed, and that any one inexperienced in mechanics can run it. The company furnishes a launch outfit comprising this engine used in connection with a flash boiler.

The Bureau Veritas, international registry of shipping, publishes a monthly list of wrecks and casualties to ships of all nations. The ships meeting with accidents are classed under the headings of steamships and sailing vessels, and are arranged alphabetically with the following information: Registration number, captain, tonnage, nationality, year built, voyage on which accident happened, date, and particulars. The latter item is given in French and English. Mr. H. Wilkinson, 26 State street, New York city, is chief surveyor for the United States. Mr. Wilkinson, before coming to America, was managing director of the French shipyard Ateliers et Chantiers de Normandie for three years, previous to which he was connected with the British Lloyds.

The Buffalo Geared Hand Blower No. 100 is described and illustrated in a folder issued by the Buffalo Forge Company, Buffalo, N. Y. The folder states that this blower is the development of twenty-six years' experience in hand blowers. All moving parts are enclosed in a protective dust-proof case. Crank motion is transmitted by a double ball-bearing spiral gear. The working parts are made of steel and phosphor bronze. The blower is said to be simple, compact, unbreakable, smooth of action, easily adjustable, and noiseless in running. Buffalo No. 99 blowers, Buffalo portable forges, and the Buffalo No. 66 drill with automatic feed, are also described in this folder, a copy of which may be had for the asking.

"A. B. C." disc ventilating fans are fully but concisely described and handsomely illustrated in Sectional Catalogue No. 161, issued by the American Blower Company, Detroit, Mich. The catalogue states that the increased demand for disc fans during the last few years is due to a growing recognition of the numerous and varied applications in which they are useful. In foundries, machine shops, engine, and boiler rooms, cold-storage plants, etc., their usefulness is becoming more and more recognized as a means for drying, lowering temperatures, removing steam, fumes, and gases. The catalogue describes and illustrates also steel plate fans, mechanical draft apparatus, exhaust fans, dry kiln apparatus, steel dry kiln trucks, heating apparatus for factories and public buildings, dust separators, steam traps, steam engines, governors, volume blowers, steam hot blast apparatus, and sectional base heaters.

Successful Marine Paints

Are simply **ZINC WHITE** paints (if they be white or light tinted). Do you know that? It is worth knowing. It solves the mystery of successful marine work once for all.

FREE: Our Practical Pamphlets:
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NEW JERSEY ZINC CO.
71 BROADWAY
NEW YORK

We do not grind zinc in oil. A list of zinc paint manufacturers is furnished on request.

Condenser Tubes

last longest if made of

"BENEDICT=NICKEL"

ELECTROLYSIS is positively resisted because "Benedict-Nickel" is an alloy of nickel and copper.

CORROSION is impossible, as the tubing is so perfectly homogeneous.

Our treatise on "Electrolysis of Condenser Tubes" is very valuable and costs you nothing. Send for it.

BENEDICT & BURNHAM MFG. CO.
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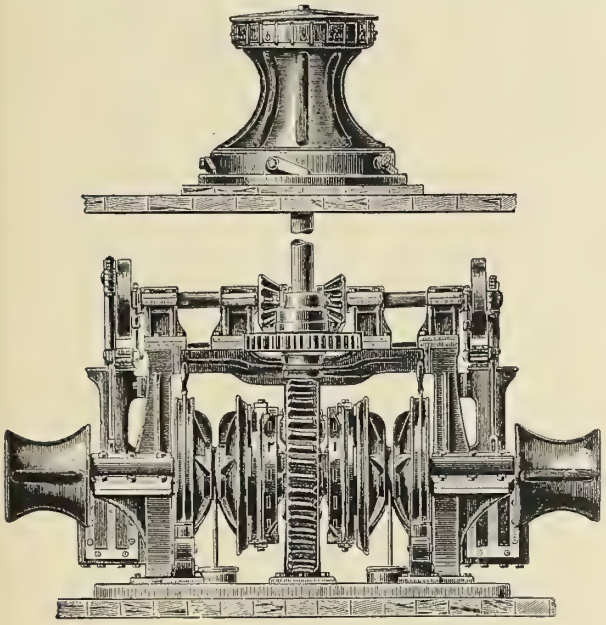

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The Textile-Finishing Machinery Co.

17 EXCHANGE PLACE, PROVIDENCE, R. I.

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We will extend the subscription of any subscriber one month for good copies of *Marine Engineering*, for either

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FEBRUARY,
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APRIL,
} **1904**

MARINE ENGINEERING, 309 Broadway, New York

A Chance Courtship

is a story of an unconventional love match, well told and beautifully illustrated. As a bit of readable fiction the story is well worth writing for. It is contained in a handsomely bound book of 128 pages, a portion of which is devoted to the attractive mountain and lake resorts along the Lackawanna Railroad. It is a book you will like to see. It may be had by sending 10 cents in postage stamps to T. W. Lee, General Passenger Agent Lackawanna Railroad, New York.

The Champion Rivet Company, Cleveland, Ohio, is distributing a card showing the detail of the boiler drums of the Pacific Mail steamers, riveted with Victor boiler rivets, manufactured by this company.

Motors for hoisting, wound for direct current, are illustrated and described in Circular 1077, issued by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. These motors are stated to be especially adapted for starting and accelerating heavy loads.

The Conneaut and Erie Interurban System is the subject of Bulletin No. 44, distributed by the Crocker-Wheeler Company, Ampere, N. J. The generating sets, booster, and other electrical apparatus in the power house were furnished by this company.

Steering gears are the subject of a mailing card sent out by the Edson Manufacturing Company, 255 Atlantic avenue, Boston, Mass. This company also makes a specialty of diaphragm pumps.

Overhead tram-rail traveling cranes, electric carriers and appliances, are the subject of Catalogue No. 18, issued by the Coburn Trolley Track Manufacturing Company, Holyoke, Mass. The company claims that many new mechanical features are embodied in its special form of track; that the rounded troughs are the basis of its strength, and that any load propelled thereon moves more easily and with less friction than is possible with any other shape. It is stated that the enclosure of the carriers within the track obviates the possibility of derailing or obstruction.

Forges, blowers, planing mills, steam and electric fans, generating sets, engines and dynamos, and other auxiliary machinery, are described and illustrated in Catalogue No. 115 issued by the B. F. Sturtevant Company, Jamaica Plain, Boston, Mass. The company states that the great diversity of its products necessitates their treatment in separate catalogues, which are now so voluminous, aggregating over thirty, that a complete general catalogue seems impracticable. By a process of selection and condensation the essential types are presented in Catalogue No. 115, copies of which will be furnished upon request, as will also catalogues regarding specific products.

Metal working machine tools are the subject of an illustrated book of 200 pages issued by the Garvin Machine Company, Spring and Varick streets, New York city. Milling machines, screw machines, forming machines, monitor lathes, chucking lathes, tapping machines, drill presses, cutter grinders, hand lathes, and special machinery are clearly and concisely described. Many novelties appear in the catalogue. The company states that special machine tools are employed to secure the uniform and economic manufacture of its tools, and that almost every piece is worked up with special tools and fixtures, assuring accuracy and uniformity. Component parts are manufactured on the interchangeable plan, and are kept in stock.

Anti-friction metal and red metallic gasket metal, manufactured by A. Allan & Son, 1 Desbrosses street, New York city, are the subject of a book of testimonials distributed by the above-mentioned firm. The Metropolitan Street Railway Company, New York city, the National Lead and Oil Works, 28 Burling Slip, New York city, the Pennsylvania Iron Works Company, Philadelphia, Pa., Armour & Company, Chicago, Ill., are among the well-known concerns who have written to express their approval of the Allan anti-friction metal. Regarding Allan's special red metallic gasket metal, a folder issued by the firm states that it is guaranteed not to blow out at 300 pounds steam pressure, and that heat will not affect it. Being a soft and pliable metal it is claimed that its use will render the most defaced and imperfect joint tight.

Buffalo steam pumps are the subject of a folder issued by the Buffalo Steam Pump Company, Buffalo, N. Y. This company's boiler feed pumps, suitable for presure up to 150 pounds, are stated to be of modern design, with all parts of great strength and durability. Each pump is provided with a full complement of wrenches. drain cocks, and sight feed lubricator.

"An Oily Tale" is the subject of an instructive as well as amusing booklet issued by the A. W. Harris Oil Company, 325 South Water street, Providence, R. I. An entertainingly illustrated account is given of the trials and tribulations of "Bill, the Engineer," and how, after using Harris oil, all his troubles vanished and he had little to do but pour on oil occasionally, smoke, and play checkers with the "old man."

Horizontal low-service compressors are the subject of Bulletin L-511, distributed by the Laidlaw-Dunn-Gordon Company, Cincinnati, Ohio. The company states that it includes under this title all compressors built for pressures of 30 pounds or less, although most of the space in the bulletin is devoted to non-jacketed machines, proportioned for pressures of 8 or 10 pounds. The machines are built with open suction for supplying air at low pressures, or with closed suction for handling carbonic acid and other gases.

Dynamos and motor generators are the subject of Bulletin No. 302, issued by the Holtzer-Cabot Electric Company, Brookline, Mass. The bulletin is an illustrated pamphlet of 32 pages, and should be of value to those interested in transformers, dynamotors, motor generators, boosters, etc. This company publishes bulletins on the subject of gas-engine ignitors, electric lathe motors, interior telephone systems, magneto generators, circuit closers, and many other subjects of interest to electricians, any one of which will be sent free upon application.

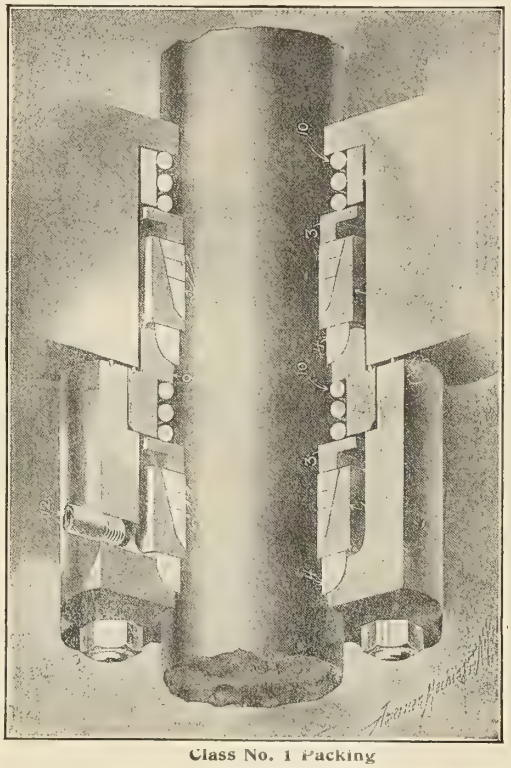
Centrifugal pumps are described and illustrated in Catalogue W-50, issued by Henry R. Worthington, 114 Liberty street, New York city.

"Plate Metal Construction" is the title of a pamphlet issued by the Coatesville Boiler Works, Coatesville, Pa. Tubular boiler fronts, self-supporting wrought-steel stacks, stand pipes, internally fired corrugated furnace boilers, digestors, compound separators, heating boilers, and other plate metal work are illustrated and described.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., is distributing a pamphlet entitled "Synopsis of the S. K. C. System." This synopsis is designed to give an outline of the products manufactured by the company, which are said to be constantly developed to meet new conditions. Bulletins devoted to new apparatus are issued from time to time and the older bulletins revised as is required.

Direct current generators and motors are illustrated and described in Catalogue No. 61, issued by the National Electric Company, Milwaukee, Wiss. The catalogue states that the generators and motors manufactured by this company combine those features of design, material, and construction which have been found most desirable by experience; that they are liberally rated, are compact, substantial in construction, and neat in appearance.

The Alden absorption dynamometer, manufactured by George I. Alden, 48 Queen street, Worcester, Mass., is described and illustrated in a pamphlet, which will be sent upon application to Mr. Alden. The pamphlet states that builders of gas engines, steam engines, electric motors, and water wheels may know, by the use of this dynamometer, the capacity and efficiency, under various conditions of speed and load, of the motors they place on the market.



Class No. 1 Packing

Metallic Packing

designed for one engine may not be suitable for another engine, therefore we design packing to fit the special condition met with Thus, packing which we apply to high-pressure rods is generally different from that for low-pressure rods.

Our great success is due largely to the fact that we consider each case separately, give a man exactly what is best suited for his engine.

We consider Class One packing, shown in the cut, to be the best on the market for marine and stationary work. This is a double packing, each set being complete in itself. The upper set of babbitt metal rings does most of the work, while the second set is in reserve in case any water or steam happens to leak through the first set. Should the first set fail, the second is on the rod ready for service

Our Packings Run for Years Without Attention.

Catalogue, Prices, and List of Users on Application.

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Main Office and Works, 427 No. Thirteenth Street, PHILADELPHIA, PENNA.

CHICAGO, 509 Great Northern Building SEATTLE, Moran Bros. SAN FRANCISCO, W. H. Pierson

BUSINESS NOTES.

A new rudder hanger has been placed on the market by the Prouty Manufacturing Company, 35 Oliver street, Boston, Mass. This device is said to be so simple that a child can hang the rudder even when the boat is moving rapidly or in rough water.

A new motor chain compound is made by the Joseph Dixon Crucible Company, Jersey City, N. J. The company states that this compound is especially prepared for the heavy chains of motor vehicles, and that it will not catch sand or dust.

A New Yacht and Engine Company.—The Excelsior Yacht, Launch, and Engine Company has erected a shop at Camden, N. J., and will engage in the manufacture of yachts, launches, and gas engines. Matteson & Drake, naval architects, The Bourse, Philadelphia, Pa., will design and supervise the construction of the hulls, and see that the motors are properly installed. Buying, selling, exchanging, repairing, painting, and winter storage will also be engaged in.

A Satisfactory Engine.—The Dutton Engineering Company, Perth Amboy, N. J., has received the following letter from Warren Cowles, Peoria, Ill.: "Your engine, as I have always thought, is the best that ever happened. Now, I have seen many gasoline engines—many good ones—but none of them are in the same class. I have had occasion to know all about this, and after three years of trouble and no pleasure I'm frank to say I've lost about three years of my life. You can use me any time you desire, and if my word is doubted I can show them. There is one thing certain—*the engine will run all the time.* I beg to remain the best pleased friend you ever sold an outfit."

THE PROFESSOR ON SHIPBOARD

A STORY

NOTHING has ever been published which contains so much every-day information which every engineer ought to know, as this book. In addition to the practical information it contains, it is a most readable story of life at sea. There are twelve chapters, as follows: I, In the Fireroom; II, Hardships of Firemen; III, Night Watch in a Gale; IV, Interview with Barney, the Oiler; V, Some Points on Lubrication; VI, Why Engines are Non-efficient; VII, Salt Water and Boiler Scale; VIII, Cleaning Boilers in a Tropical Port; IX, How to Use Indicators; X, Simple Explanation of the Indicator; XI, Overhauling the Machinery; XII, Painting the Pipe System. 100 pages. By C. A. McAllister. **Price $1.00 Postpaid.**

For sale by MARINE ENGINEERING
309 Broadway, - - New York City

Forgings of Every Kind, and made for any specifications or requirements, including steamship work, are supplied by Mason G. Worth & Company, Real Estate Trust Building, Philadelphia, Pa., who will furnish blue prints and specifications upon application.

Will Insure Its Employes.—The Crocker-Wheeler Company, Ampere, N. J., will give its employes, so it is reported, the benefit of an insurance plan which it will soon put in operation, the company paying all the expenses. The lives of all men who have been in the company's service for three years, and are in good standing, will be insured at the company's expense. If any employee cannot pass the medical examination, an amount equivalent to the premium which would be paid will be placed in a savings bank to draw interest, and will pass to his family at his death.

Broken staybolts, bad water, and imperfect combustion are stated by the Falls Hollow Staybolt Company, Cuyagoga Falls, Ohio, to be the chief factors in causing excessive motive power expenses. In a pamphlet issued by the company much information is given regarding the use of hollow staybolts in marine and railway boilers, and the results of tests made on hollow and solid staybolts are given. It is stated that the Falls Hollow Staybolt Company's staybolt is a piled iron—it is fibrous, the fibers long and made homogeneous by several workings; the material worked being the best charcoal iron. Numerous discussions by engineers regarding staybolts are included in the pamphlet, and any one interested in the subject should not fail to send for a copy.

A novel gas-engine starting device and electric-light plant has just been installed on the launch *Aranca*, owned by Arnold Schlaet, New York city, by the Richardson Engineering Company, Hartford, Conn. It is one of the most complete electric-light plants this company has installed, consisting of generator, storage batteries, completely appointed switchboard, special flat type of ceiling lamps, side lights, binnacle light, riding light, anchor light, portables, etc. The outfit is arranged so that one may start his gasoline engine by operating a motor starting box located at the steering wheel, which draws current from the storage batteries, and, using the generator as a motor, turns the engine over the revolution or so that is necessary for it to pick up. The lense mirror arc search light, which is located well forward, is also controlled near the steering wheel, and has a switch at this point giving entire command of the search light, engine, and steering wheel from one point. Another feature of this installation is the fact that a new form of incandescent lamp is used which is of the flat door-knob shape with silvered back, thus doubling the amount of light. The lamps have double filaments to give double life. It is a very complete equipment for the launch and the comforts and advantages are many.

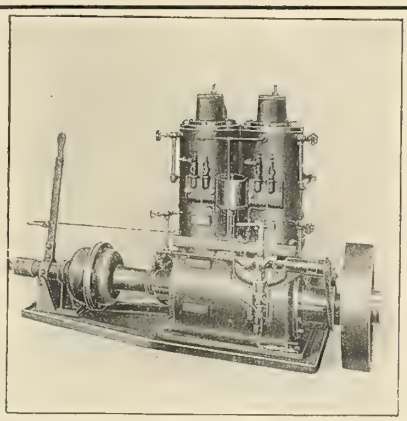
THE MIETZ & WEISS
Kerosene and Gasoline Engines

Marine and Stationary, 1 to 60 H. P.

Adopted by United States and Foreign Governments.
Runs with common Kerosene, Distillate or Fuel Oils. It will pay you to consult me before placing your order elsewhere.

For Propelling Boats, Pumping, Electric Lighting, Charging, and all other purposes Direct Coupled or Belted Dynamos. Highest Award Direct Coupled Engine and Dynamo, Paris Exposition, 1900. Gold Medal, Pan-American Exposition, 1901. Gold Medal, Charleston (S. C.) Exposition, 1902.

A. MIETZ, 128-138 Mott Street, New York, U. S. A.
Send for Catalogue, Dept. 110.
Hoists, Pumps, Air Compressors, Portable Outfits, Dynamos.



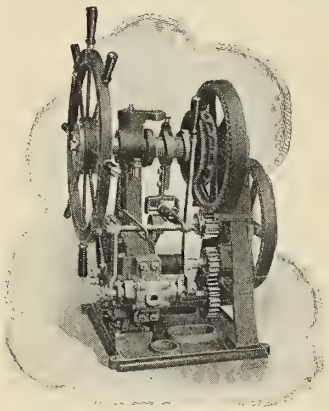
CARE OF MARINE BOILERS.—Mr. William J. Kennedy, who for twenty-seven years had charge of the boilers of the many vessels connected with the American line, has established himself at 89 West street, New York city, as a general contractor, and to supply all classes of labor. Mr. Kennedy will make a specialty of looking after boilers in vessels of all kinds, and making repairs in connection with tubes, furnaces, and back ends, together with scaling and cleaning them, etc. Another feature of his business is the care of hulls and bunkers, together with scaling bilges, painting ships, etc.

OIL AND GRAPHITE FOR AIR CYLINDERS. An engineer writes the Joseph Dixon Crucible Company, Jersey City, N. J., as follows: "I have been using Dixon's finely pulverized flake graphite, No. 635, in air cylinder of air pump with most satisfactory results. I mixed about a tablespoonful with half-pint of cylinder oil and put it in squirt can, and have been giving the air cylinder (through oil cup) about half a teaspoonful in twenty-four hours. Of course I keep the contents in the can well shaken up. Before I used the graphite, pump was running hot and groaning and squeaking all the time. Since using the graphite and cylinder oil in the manner mentioned I have not heard a groan or a squeak, and the pump runs cool and will pump all the air wanted at any time."

REPORTS ON SHOP CONDITIONS deal with the numerous factors which make up the complete manufacturing plant. They are written with two purposes in view—the immediate betterment of present conditions and a systematic policy to follow for future growth. It is well understood that nearly every shop is particularly efficient in some directions, but weak in others. A concern that can combine the good features of all will readily distance competitors. The preparation of these reports is the specialty which has come to be known as "modernizing," and a firm which has been successful in this field is Dodge & Day, modernizing engineers and contractors, Nicetown, Philadelphia, Penn. This firm issues three instructive bulletins—Nos. 123, 136, and 144. The latter is a comprehensive pamphlet explaining the nature of the service rendered, is fully illustrated by charts, and quotes specific cases of work completed for well-known industries. The character of the firms employing Dodge & Day is seen in the mention of a few: Link-Bolt Engineering Company, Westinghouse Electric and Manufacturing Company, Ingersoll-Sergeant Drill Company, Firth-Sterling Steel Company, Jeanesville Iron Works Company, New Haven Manufacturing Company, Phœnix Cement Company, and others of equal prominence

ANNEALING SPOTS IN ARMOR PLATE. A special application of the thermit process of welding has been found in the annealing of spots on armor plate, the face of which has been hardened by carburisation. It is impossible to work such plates with chisel or drill, and the spots up to the present have had to be heated by an oxyhydrogen flame, or by electricity. Both are exceedingly slow processes, as the application of the flame has to be altered repeatedly with the work of drilling. For annealing electrically a very bulky equipment is necessary. The plate will be annealed right through by pouring the liquid thermit (over the rim of a flat-bottomed magnesia crucible) so as to have a layer about one inch thick on the spot. This is left to cool for about an hour, and is then removed. The annealing is localized, the material outside the annealing zone remaining perfectly hard. The operation is based on the well-known property of the alumino-thermic reaction, that the two layers formed in the crucible after the mass has burned down, are perfectly distinct; the lighter aluminum slag floating on the top, and the heavy liquid metal resting on the bottom. The slag will coat with a thin layer any metal object with which it comes in contact, and is so absolutely refractory that the highly overheated liquid steel cannot burn through it. The Goldschmidt Thermit Company, 43 Exchange Place, New York city, is the American agent for thermit.

THE DAKE PILOT HOUSE STEAM STEERER.



A Simple, Compact and Durable Machine.

Occupies Small Floor Space.

Write for descriptive circulars and prices.

THE DAKE ENGINE CO.,

GRAND HAVEN, MICH.

NEW YORK OFFICE, ROOM 612. 85 LIBERTY ST.

THE MERRILL-STEVENS ENGINEERING COMPANY, Jacksonville, Fla., has equipped its plant with oil-burning furnaces. The company is about to build new shops and a large drydock, capable of docking the Clyde Line ships.

THE HYDE WINDLASS COMPANY, Bath, Maine, reports that it is building several electric capstans for the floating drydock now building for the government for Cavite, Philippine Islands.

A KEY RING with an identification tag will be sent upon application to any reader of MARINE ENGINEERING by the Garlock Packing Company, 136 Liberty street, New York city.

THE WATSON-STILLMAN COMPANY, manufacturer of hydraulic jacks, has removed its office and stock from 204-210 East 43d street to 46 Dey street, New York city. The company's machinery has been removed to its new works at Aldene, Union County, N. J.

A NEW CORPORATION.—W. S. Hill and F. A. Ensign, advertising agents, at Pittsburg, Pa., doing business under the name of W. S. Hill & Company, have formed a corporation under the name of the W. S. Hill Company. The incorporation was needed because of the great increase of the firm's business.

THE GASOLINE STORAGE TANKS for motor boats manufactured by Alfred B. Sands & Son, 134 Beekman street, New York city, are intended to add greatly to the safety of a gasoline launch, as it is claimed the tanks are so constructed as to render leaks impossible, thus avoiding all danger of explosions.

THE ENGINEERING SPECIALTIES manufactured by The Lunkenheimer Company, Cincinnati, Ohio, are exhibited at the St. Louis fair in Machinery Hall, location 5-G, Block 26. Those interested in valves, whistles, and all other engineering specialties will find this company's exhibit well worth looking up.

THE CROWN PRINCE OF JAPAN, who has recently built what is said to be "the most magnificent palace in the world," ordered all the engineering work from American firms. The H. W. Johns-Manville Company, 100 William street, New York city, states that it furnished all the heat and cold insulating materials.

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" 3, A. L. Jones, 289 Champlain St., Detroit, Mich.
" 4, Jas. A. Macauley, 5802 Indiana Ave., Chicago, Ill.
" 5, Otto Boettger, 1035 E. Hopkins Ave., Baltimore, Md.
" 6, Wm. Arste, 322 Pine St., St. Louis, Mo.
" 7, Wm. T. McElwee, Box 1556, Portland, Me.
" 9, Wm. Bridges, 784 1-2 12th St., Milwaukee, Wis.
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" 15, R. C. Skinner, 622 Louisa St., New Orleans.
" 17, Jas. D. Robinson, 341 Isabella St., Newport, Ky.
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" 20, Jos. B. Barry, 206 Keel St., Memphis, Tenn.
" 21, Lawrence Miller, 304 E. Jackson St., Vicksburg, Miss.
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" 24, Jas. B. Flach, 327 N. 4th St., Paducah, Ky.
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" 30, E. R. Humphrey, 239 Water St., Pittsburg, Pa.
" 33, James J. Waters, 283 Hudson St., New York, N. Y.
" 35, William M. Coombs, 36 East St., San Francisco, Cal.
" 36, Jos. Thomas, 57 Sea St., New Haven, Conn.
" 37, John B. Bender, 1215 Evesham Ave., Toledo, Ohio.
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" 40, Chas. Drouet, 1003 Ave. I, Galveston, Tex.
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" 43, Thomas J. Coyle, 627 Superior St., Port Huron, Mich.
" 44, Chas. J. Sullivan, 489 1st St., Manistee, Mich.
" 45, W. L. Salter, Care O. S. S. Co., Savannah, Ga.
" 46, D. W. Farrell, Clayton, N. Y.
" 47, J. R. Cook, Sault Ste. Marie, Mich.
" 48, Alfred Hegemer, 140 E. Park St., Sandusky, O.
" 51, H. S. Connell, 12 Ransom St., Muskegon, Mich.
" 53, Harry Stone, Box 445, Marine City, Mich.
" 55, Archie Stalker, Box 883, Cheboygan, Mich.
" 57, E. B. Meeker, 71 Abeel St., Kingston, N. Y.
" 58, E. Capers Haselden, Box 31, Georgetown, S. C.
" 59, Geo. F. Keating, 74 Webster St., E. Boston, Mass.
" 62, N. S. Lawrence, 30 Connecticut Ave., New London, Conn.
" 63, M. J. Burke, 152 Sheridan Ave., Albany, N. Y.
" 65, W. C. Palmer, Care Consumers' Coal Co., Charleston, S.C.
" 67, James K. Dole, Saugatuck, Mich.
" 70, Chas. T. Smith, 665 Commercial St., Astoria, Ore.
" 72, Wm. T. Findlay, 130 W. Bridge St., Oswego, N. Y.
" 73, E. M. Donahue, 1308 Cherry St., Green Bay, Wis.
" 75, Wm. D. Hemenway, Alexandria Bay, N. Y.
" 76, Orson Vanderhoef, Grand Haven, Mich.
" 77, John P. Hall, 1215 Huron St., Manitowoc, Wis.
" 78, J. P. Burg, 2722 Minnesota Ave., Duluth, Minn.
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" 85, John A. Packard, 623 Merchant St., Alpena, Mich.
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" 87, Geo. B. Milne, 809 Fourth St., Detroit, Mich.
" 88, C. O. Chapman, S. B. Canal, Sturgeon Bay, Wis.
" 89, Geo. E. Willard, 4 Isabella St., Ogdensburg, N. Y.
" 91, A. L. McLaren, 130 W. Walnnt St., Ashtabula, O.
" 92, Jos. D. Budd, Box 50, Sta. I, Saginaw, W. S., Mich.
" 93, W. J. Cook, 2220 G. St., N. W., Washington, D. C.
" 94, Geo. R. Jones, Box 222, Washington, N. C.
" 95, P. J. McMahon, Box 199, Key West, Fla.
" 98, Bert Hamlin, 114 Exchange Place, New Orleans, La.
" 100, Jas. P. Lynch, Honolulu, H. I.
" 101, J. K. Cotton, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., South Haven, Mich.
" 103, A. E. Pittman, Box 378, New Bern, N. C.

TRADE PUBLICATIONS.

Electric motors, direct connected to machinery in manufacturing plants, are the subject of a folder issued by the Northern Electrical Manufacturing Company, Madison, Wis. This folder is entitled "An Old Saw with Re-Set Teeth," and calls attention to the economy of using direct-connected motors in place of using shafting, belting, etc., with the necessary loss of power.

Gas and oil engines are the subject of an illustrated catalogue issued by A. Mietz, 128 Mott street, New York city. Regarding the marine type of oil engines the catalogue states that they are furnished with reversing clutch, propeller, stuffing box, coupling, and wrenches. These engines are made in sizes from 1 to 60 horse power, weighing from 175 pounds to 3,500 pounds. The catalogue contains many testimonials from users of the engines.

A vest-pocket launching guide is issued by the White Craft and Power Company, Port Richmond, Staten Island, N. Y. This is a cloth-bound booklet of 72 pages and will be sent upon receipt of ten cents. It contains much information useful to yachtsmen, such as water distances between well-known points, explanations of compass terms, location of light stations, giving height and characteristics, measurement rules and formulæ, yacht-club flags (with colored plates), time computation on the Atlantic coast, etc.

Drawing tables, map cases, blue printing apparatus, and other draftsmen's supplies, are described and illustrated in catalogues issued by the American Drafting Furniture Company, Rochester, N. Y. Regarding its adjustable drawing table a folder states that it possesses lightness, strength, durability, and compactness when not in use. It may be adjusted to many positions, whether for drafting, sketching, or painting. A person may use it either standing or seated. This table is provided with a ledge for holding triangles and other drawing instruments, and with a side shelf for ink or paint which remains level whatever may be the position of the table.

The Webster Feed-water Heater and Purifier is the subject of an illustrated folder distributed by Warren Webster & Co., Camden, N. J. This folder states that the Webster heater admits the precise amount of exhaust steam which is required for the heating of the incoming water, the amount of which is governed by the boiler requirements, and as it enters the heater the water is sprayed and condenses the exhaust steam present, forming a partial vacuum, which, in turn, induces a further flow of exhaust steam into the heater. It is stated that the exhaust steam is not only condensed but that its energy of motion is arrested, and its water of condensation falls with the now highly-heated incoming water into the filter and purifier below, there to be cleansed and freed from any impurities, and then to rise highly heated and ready for the boiler feed pump.

A new feed-water heater, purifier, and oil separator is described in a pamphlet published by J. G. Duck, Milwaukee, Wis. This invention is manufactured by the Steam Appliance Company, Milwaukee, Wis. The inventor claims as a novel feature an open spiral chamber, wherein the supply water winds down an incline having a tight bottom, with sides extending upward far enough to prevent the supply water from overflowing. The spaces between these descending spirals form the passage ways for the exhaust steam. The steam ascending envelopes the descending water, causing it to absorb the heat in the exhaust. Another feature claimed is the eccentric coil in the supply pipe which retains the water long enough in the steam storage chamber to remove the chill before it is sprayed into the spiral. The device is constructed entirely of cast iron, brass, and copper. Diagrams accompany the pamphlet, naming and describing the working parts of the invention.

When writing to advertisers please refer to MARINE ENGINEERING.

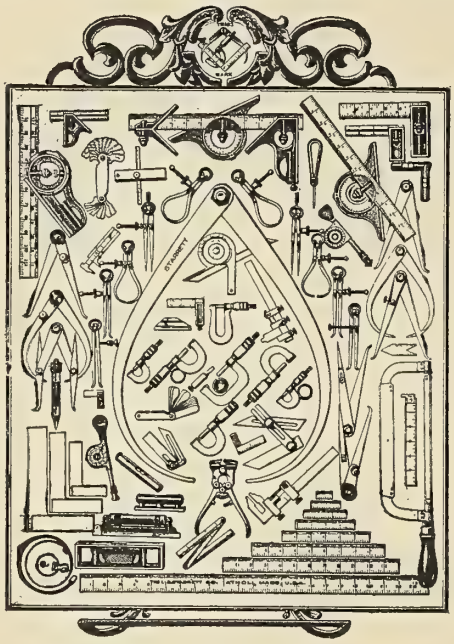
Tackle blocks, cargo hoists, diaphragm pumps, trucks, wagon jacks, etc., manufactured by the Boston and Lockport Block Company, 160 Commercial street, Boston, Mass., are illustrated in a folder with a card-board cover made in imitation of a block, which this company is distributing.

Marine gasoline motors are described by the Buffalo Gasoline Motor Company, 1280 Niagara street, Buffalo, N. Y., in an illustrated catalogue it is sending out. The catalogue states that the Buffalo motors have solid one-piece, steel-forged crank shafts, and mechanically operated inlet valves. All motors are equipped with metal enclosed bases, with detachable panels, so that access to all parts is easy. Solid-steel forged valves are used. There are five heavy bearings in the base of the motor, assuring firm journals for crank shafts. These bearings are held in place by double lock nuts and split keys. Motors are completely water jacketed, including head and valves. There is no packing on motor except in the water jacket. The Buffalo engines are of the four-cycle type, and are made in sizes from 2 to 40 horse power.

The pumping machinery manufactured by Fairbanks, Morse & Co., Chicago, Ill., is illustrated and described in an eighty-eight-page catalogue published by that company. Air pumps, ballast pumps, bilge pumps, boiler feed pumps, circulating pumps, duplex power pumps, geared pumps, hydraulic pumps, marine pumps of many styles, vacuum pumps, and a great variety of other pumps, and pumping machinery are described in this catalogue, which states that the company is continually adding to its line of patterns, and is prepared to offer a pump suitable for almost any service to which direct-acting pumps can be applied, and that it is impossible to mention in one catalogue all the different sizes and types the company makes. Numerous diagrams are given, describing and naming the working parts of the Fairbanks-Morse pumps.

Cutting-off tools, bell centering punches, and all-steel miter boxes are described in a folder sent out by the Goodell Manufacturing Company, Greenfield, Mass. Regarding the cutting-off tool the folder states that it is a great time-saving device, and that it quickly and smoothly cuts any kind of round stock up to one-half inch in diameter. It may be used, it is claimed, with any lathe, the jaws of the tool holding the stock to a running fit, the cutter being instantly fed into the work by a pressure of the handles. It is constructed with a stop, enabling square and even lengths to be cut away with great rapidity. The centering punch is said to quickly and accurately center both round and square stock. The miter box, the folder states, is made entirely of Bessemer steel, thus avoiding all liability of breakage. It has automatic stops to hold up the saw, allowing the operator to use both hands in placing the work.

Marine gas and gasoline motors, reversible propeller wheels, and launch trimmings, are described in an illustrated catalogue issued by the Hildreth Motor and Pump Company, Lansing, Mich. The Hildreth motors are of the two-cycle type. The cylinders and pistons, so the catalogue states, are cast from a mixture of irons selected especially because they are of sufficient density and hardness to resist wear. The cylinders are bored four times with especially designed tools. The pistons are turned and the rings are turned and bored, then cut in two and sprung together, and clamped and turned to the exact size of the cylinder bore to make an absolutely gas-tight job. The cylinder and cylinder heads are water jacketed. Crank shafts are forged from a solid-steel bar. The connecting rod is bronze. The cylinders are equipped with sight-feed lubricators. The ignitors are of the make-and-break or jump-spark types, as may be preferred. The crank is entirely enclosed in the body of the engine, preventing dust and grit from getting into the end of the cylinder, with the result, the company claims, of greatly prolonging the life of the engine.



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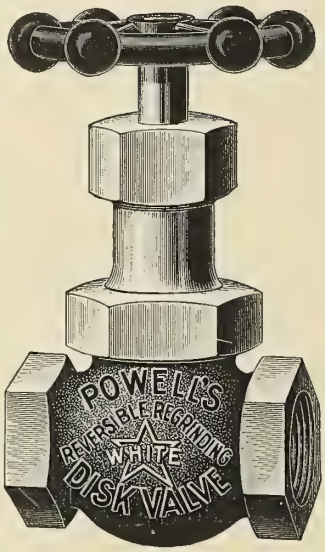

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Please Mention This Publication

Free exhaust valves are discussed in a circular letter mailed by Schutte & Koerting Company, 12th and Thompson streets, Philadelphia, Pa.

Air and gas compressors are illustrated and briefly described in a pamphlet issued by the Rand Drill Company, 128 Broadway, New York city. Of the Rand-Corliss Class BB compressor, the pamphlet states that for permanent installations, particularly for centralized plants, it has been found to be very durable and economical. This compressor is of the duplex pattern, built with both girder and tangye frames, for running either condensing or non-condensing, and with all combinations of duplex and cross-compound steam, air, or gas cylinders. The Class B compressors are of the girder frame duplex pattern type, with the steam and the air cylinders tied tandem to each other. The Imperial Type 10 steam-driven compressors are of the duplex pattern, employing a heavy box bed with the steam and the air (or gas) cylinders at opposite ends, and the balance wheel nearly in the center. They are self-contained and self-oiling. The steam cylinders on Type 10 are made both duplex and compound. Class C straight line steam-driven compressors are for hard usage, when the machine is to be moved from place to place and to receive little attention. Several other types of compressors are described in this pamphlet, a copy of which may be had upon application.

Canoes are discussed in a folder sent out by the Old Town Canoe Company, Old Town, Me. Strength and thorough protection from moisture are among the advantages claimed for this company's product.

The Rogers' Universal Cost System, devised by W. S. Rogers, of the Bantam Manufacturing Company, Bantam, Conn., is illustrated and fully described in a pamphlet published by Mr. Rogers. This cost card system is the result of Mr. Rogers' many years of experience as an office and factory manager and owner, and aims to inform the manufacturer of the exact cost of a piece of work, and whether any unnecessary labor has been expended upon it, thus securing the greatest possible output with the least possible expense. Shipyard and factory managers will find this pamphlet of value.

Blow-off valves and brass globe and angle valves are the subject of a folder issued by the Star Brass Manufacturing Company, from its New York city office, 38 Cortlandt street. Of the blow-off valves the folder states that they are guaranteed to close tight and always remain so, that they are not affected in any way by scale or dirt, and that the highest steam pressure does not affect their opening or closing. Regarding the globe and angle valves the folder says that they are tested to 500 pounds pressure, that they are warranted not to leak, and that all working parts are renewable.

Drawing paper is the subject of a folder issued by the Kueffel & Esser Company, 127 Fulton street, New York city. The folder states that of the various materials used by draughtsmen none require more careful selection than drawing paper. Instruments, scales, pencils, inks, etc., may be replaced when unsatisfactory, but drawing paper cannot be replaced without destroying all the work that has been done on it. The Keuffel & Esser papers are mounted stretched, and are air dried. The company's 500-page catalogue of drawing materials, surveying instruments, and measuring tapes will be sent free upon application.

The proper lubrication of pneumatic tools is discussed in a folder issued by the Philadelphia Pneumatic Tool Company, 22d street and Allegheny avenue, Philadelphia, Pa. The folder states that this form of lubrication is one of the most difficult problems of modern mechanics, as the tools run at very high speed in dry air and under great pressure. Ordinary petroleum oils, so it is stated, when used on pneumatic hammers or drills, are soon evaporated or carbonized, leaving the working surfaces dry and bare. If to prevent this, heavy animal oils are used they quickly gum under the action of the air, clogging the tool, and reducing its speed. In order to meet these difficulties the Philadelphia Pneumatic Tool Company has placed on the market a lubricator called "Pneulubric," which is made in two forms, liquid or solidified. The liquid form is intended for use on pneumatic hammers, riveters, and air compressors, and the solid form is for rotary drills.

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With Renewable Bronze or Babbitt Seats.
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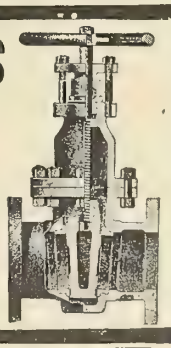

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New York, Park Row Building. **WALWORTH MFG. CO.,** Boston, 128 Federal Street.
Write for our BLUE CATALOGUE "D" showing complete line of engineers' pipe fitting tools.

The Triangle Protractor Company, Worcester, Mass., calls attention in a mailing card to its 9-inch, 45-degree, all-celluloid triangle, with a sliding bar protractor that can be read to ten minutes.

The steam yachts, launches, passenger boats, tugs, gasoline launches, and other craft built by William R. Osborn, Croton-on-Hudson, are described in an illustrated 50-page catalogue just issued, which states that Mr. Osborn builds boats of all descriptions, either from his own design or from the designs of others.

Graphite pipe joint compound is the subject of a booklet sent out by the Joseph Dixon Crucible Company, Jersey City, N. J. This compound is said to make thoroughly tight joints for steam, water, air, oil, brine, and gas piping, and the claim is made that it resists heat, cold, acids and alkalies, and that it protects the threads from corrosion of every sort.

The steam traps for marine use manufactured by Richard J. Flinn, West Roxbury, Mass., are the subject of a folder illustrating and describing these traps. It is stated that the Flinn traps will work against any back pressure less than the pressure in the trap, or they will discharge to a higher level than the traps—that is, to a height of about two feet for every pound pressure carried.

A pamphlet describing the works of the Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa., discussing their industrial and sociological aspect, profusely illustrated and handsomely bound in several colors, is the latest product of the publication department of that company. The electric machinery manufactured by this company is but lightly touched on, the object of the pamphlet being to describe the company's plant and the life of its employees.

A portable forge and furnace manufactured by F. W. Braun Company, San Francisco, Cal., is described and illustrated in a booklet issued by the company. The booklet states that the machine can be easily removed from place to place without taking it to pieces. The fuel used is gasoline, which is burned in a Cary hydrocarbon burner, giving a flame of great intensity, which, with the peculiar construction of the furnace and forge, adapts it to a wide range of use. The furnace is claimed to heat metal evenly, quickly, uniformly, and without producing scale.

Slotting machines are illustrated and described in Catalogue 38, issued by the Newton Machine Tool Works, Philadelphia, Pa. The catalogue states that all sizes of these machines have relief tool apron and quick-return motion. All sizes above the 10-inch stroke of the fixed type have an adjustable ram guide. The circular tables of these machines are graduated and have a full bearing on the lower saddle, the worm wheel being set in the saddle, and the tee slots for clamping the work have ample metal over wing of slots. Carriages have quick-acting, variable-feed motion in all directions. Rod drilling machines, cold saw cutting-off machines, saw grinding machines, and other machine tools are also illustrated and described in this catalogue.

Double-acting air pumps and jet condensers are illustrated and described in a folder issued by Dean Brothers' Steam Pump Works, Indianapolis, Ind. Regarding the 10 by 16 by 12-inch pump and condenser the folder states this is a new type of air pump and condenser. The air pump cylinder is double acting. There are no valves in the piston. Both suction and discharge valves are in the valve chest at the side of cylinder, hence the valve area is not limited by the size of the piston. All valves are quickly accessible through hand holes. The piston rods are separable at the cross heads. Tapering keys are used to hold them in place. The cylinder head can be easily removed and taken out of the way, for inspecting interior of cylinder or for repacking the piston. The piston rod stuffing box is provided with a water seal to prevent air from entering. There are no "air pockets" in cylinder or passages.

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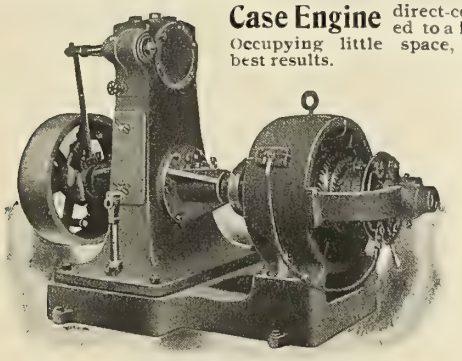

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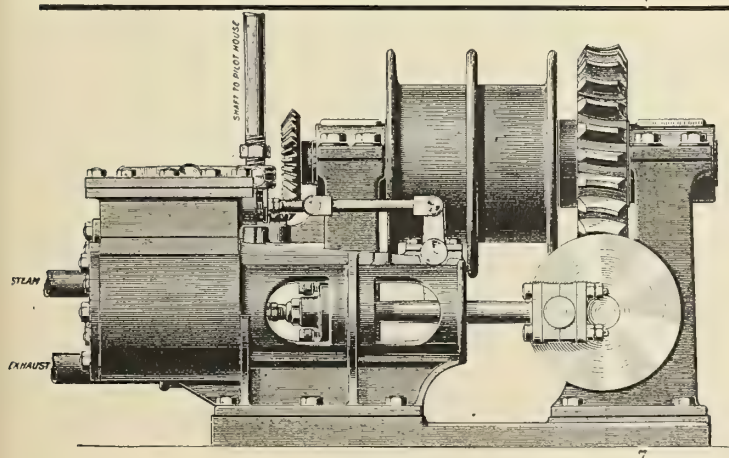
The monthly calendar of the Crandall Packing Company, 123 Liberty street, New York city, may be had for the asking. This calendar calls attention to Helios high-pressure ring packing for marine work, and to the many other varieties of packing made by this company. Of the marine packing the calendar states that it is made in rings—a fit for rod and box—or put up in coils from which the engineer can cut rings to suit his special requirements. It has a rubber-cored center providing a cushion for the rod to work against, and it is claimed that it will not burn or blow out under the highest pressure.

Yachtsmen and yacht and boat builders will want a copy of the handsomely illustrated 64-page catalogue issued by the Racine Boat Manufacturing Company, Muskegon, Mich. This company was in business twenty-one years at Racine, Wis., but in May, 1903, its entire plant was destroyed by fire. The business of the company had grown to such an extent that the water frontage to be had at Racine was not sufficient, so that a new fire-proof plant has been erected at Muskegon, Mich., occupying 10 1-2 acres of dock property, including facilities for building almost any style of vessel from a 21-pound racing shell to a 300-foot steam vessel. Motor boats of all sizes, cabin launches, working boats, racing machines, gasoline motors, water-tube boilers, marine steam engines, wooden and steel steam and gasoline yachts, shallow-draft turbine steamers, sailing craft of many types, row boats, canoes, life preservers, and other yachting accessories are fully illustrated and concisely described in this catalogue, a copy of which will be forwarded upon application.

The steam steering gear made by the Dake Engine Company, Grand Haven, Mich., is illustrated and described in a folder issued by the company, which states that the Dake steam steering gear has been designed to meet the wants of both tug and vessel owners for a light, compact, and efficient machine for pilot-house service. It consists practically of two standards on a flat base, supporting a shaft carrying a chain wheel for rudder chain, and also a hand steering wheel. The engine, which is of the Dake type, is made to start, stop or reverse by means of a lever connected to the hand wheel, which is not keyed to the shaft, but revolves loosely, and it requires only a slight movement of the hand wheel to port or starboard to start or stop the gear at any point. Arrangements are made to change the gear from steam to hand power in a few seconds. The gear is equipped with an automatic closing device consisting of a traveling nut, which locks into two stationary ones and closing the steam valve at the hardover points of quadrant. These lock nuts can be adjusted to allow the right quadrant travel. The gear is furnished also with a hand lever attached to throttle valve, and it is optional with the pilot to use either this lever or hand wheel for steering. An indicator is also supplied which shows the position of the rudder at all times.



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"Great Lakes" Air Compressors are described and illustrated in a pamphlet issued by the Great Lakes Engineering Works, Detroit, Mich.

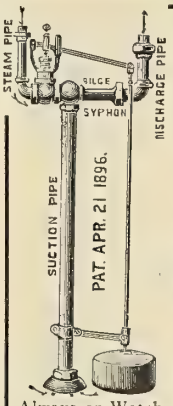
The Garlock Packing Company, Palmyra, N. Y., is distributing a catalogue calling attention to packings and gaskets, which the company states are made in more than a hundred different styles, for every conceivable engineering purpose. This company has opened branches in all the principal cities in the United States, and is thus prepared to make deliveries on short notice from any location.

Yacht plumbing specialties are described and illustrated in a 65-page catalogue issued by Alfred B. Sands & Son, 242 Water street, New York city. No yachtsman or ship builder should fail to send for a copy of this catalogue, for besides the necessities of yacht plumbing there are described a thousand and one little conveniences which no one would willingly be without after once hearing of them. Water heads, smoke plates, sea leads, mooring buoys, ventilators, and other yachting accessories are also listed.

Ten-foot mills, for use of high-power tool steel; 3 by 36-inch turret lathes; 108-inch Bement lathes, electrically driven; 90-inch driving wheel lathes; verticle milling machines; hydraulic angle and bar shears; hydraulic splitting shears, and other machine tools, are described and illustrated in the latest number of the *Progress Reporter*, published by the Niles-Bement-Pond Company, 136 Liberty street, New York city. This publication is issued every few weeks, and any one who may desire to receive free copies regularly will be put on the mailing list upon application.

"One Pound of Coal Compelled to do the Work of Two Pounds of Coal" is the title of a booklet issued by the Asbestos and Magnesia Manufacturing Company, Land Title Building, Philadelphia, Pa. Referring to the non-conducting properties of carbonate of magnesia, which the company uses for its pipe and boiler coverings, the booklet claims that magnesia pipe and boiler coverings will save their cost many times over on account of the great saving of coal, arising from increased steam efficiency, due to lack of radiation. A copy of this pamphlet will be forwarded upon request to readers of Marine Engineering.

Equilibrium circulators, with steam-heating attachment, are illustrated and described in a pamphlet issued by H. Bloomsburg & Co., 712 Dolphin street, Baltimore, Md. The pamphlet states that this device equalizes the temperature of all parts of the boiler, thus preventing the unequal expansion and contraction, with consequent leaks, due to such straining. The steaming capacity is claimed to be increased 5 to 15 per cent., and the deposit of mud and sediment prevented. This company also manufactures a steam jet which, it claims, gives a draft equal to a power fan, and which may be applied to any stack, greatly increasing the draft with a minimum amount of steam.



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The cheapest, surest and best way of keeping the holds and bottoms of vessels and boats of every kind free of water.

Three sizes, with capacity from 1,500 to 3,000 gallons per hour.

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AUTO-BOAT OWNERS AND OTHERS:

Have for sale one 60 h. p. 4 cycle 4 cylinder, jump spark motor; all ready to install in boat. This motor requires much less space than usual, weighs 1300 lbs., is in first class condition, and sold for no fault.

ALSO

One 25 h. p. Buffalo, outfit No. 12 of 1903 catalogue.

ALSO

One 7½ h. p. motor.

All three motors have been used a short time only, have been put in the best of condition by practical workman, and are offered at half price to insure quick sale Better write for particulars.

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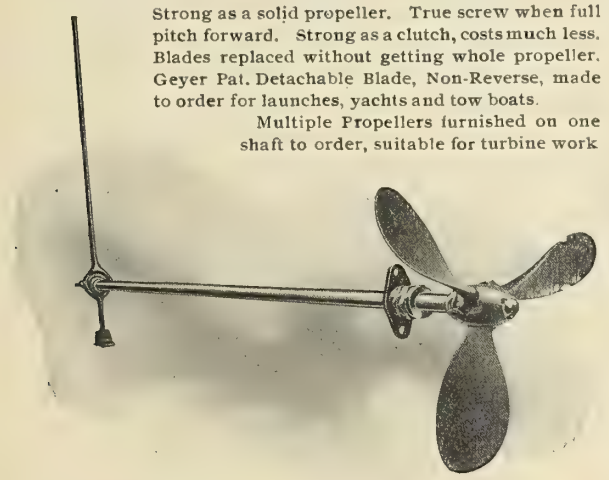

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Chapter I. deals with the early installation of electric equipment.

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Chapter IV. is devoted to electric fixtures, fittings, joints, ducts, insulation, and other minor details which are of great importance for the successful operation of a plant.

Chapter V. is devoted to a sketch of the most recent practice in the use of electricity for auxiliaries. The use of the electric storage battery on board ship is also considered.

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An Appendix contains chapters VII. and VIII.

Chapter VII. comprises detail drawings and description of a lighting plant for launches. Written by D. A. Richardson.

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MARINE ENGINEERING, 309 Broadway, New York

A book of testimonials from satisfied purchasers, regarding the working of its marine gasoline engines, is issued by the Buffalo Gasoline Motor Company, Buffalo, N. Y.

Electric light plants for launches, yachts, homes, shops, hotels, and summer cottages, are illustrated and described in Bulletin No. 3, issued by the Richardson Engineering Company, 36 Pearl street, Hartford, Conn.

Wire rope lubrication is discussed in a pamphlet issued by the Joseph Dixon Crucible Company, Jersey City, N. J., which will be found interesting to users of wire ropes and cables.

Diaphragm pumps, bilge and deck force pumps, steering gear, and other yacht and ship appliances, are the subject of the latest "hang it" mailing card issued by the Edson Manufacturing Company, 255 Atlantic avenue, Boston, Mass.

The double falcon wrench, "a wrench for the electrical-fixture man, which has 1 3-4 inches off-set to allow work close to the wall or ceiling," is described and illustrated in a folder sent out by the Applied Device Company, Springfield, Mass.

Wire rope and fittings are the subject of a 75-page catalogue issued by the American Steel and Wire Company, The Rookery, Chicago, Ill. Towing hawsers, mooring lines, tiller rope, and ships' rigging are among the products listed.

The electric fans made by the Sprague Electric Company, 527 West 34th street, New York city, are described in a catalogue published by this company. Swivel and trunnion desk fans, 12 and 16-inch fan motors, ceiling fans, and fans of many other types and sizes are illustrated in this catalogue.

"Summer Comforts" is the title of a booklet issued by the Fort Wayne Electric Works, Fort Wayne, Ind. This company's idea of how to keep cool and comfortable during the summer heat is to keep the air in the office, factory, or home in constant circulation by means of a Wood fan motor.

Leather packings are the subject of a folder issued by E. F. Houghton & Co., 240 West Somerset street, Philadelphia, Pa. The folder states that these packings are made from Vim leather, which the company tans especially for its packings, and that they are in use in a large number of manufacturing plants as well as in two departments of the United States government.

BUSINESS NOTES.

ALFRED B. SANDS & SON, manufacturers of yacht plumbing and other marine specialties, have removed from 134 Beekman street to larger quarters at 242 Water street, New York city.

FIVE HUNDRED KINDS of engineers' tools given away.—The fibrous and metallic packing made by the France Packing Company, 6514 State road, Tacony, Philadelphia, named by them the "steam stopper" brand, is intended for air, oil, water, and ammonia, as well as for steam packing. In order to bring this packing into more general use the manufacturer is offering a list of more than 500 tools for engineers, master mechanics, and superintendents of motive power. A full explanation of the method of giving out these tools may be obtained by application to the company.

"GLADIATOR" COMBINATION GASKET.—The New Jersey Asbestos Company, Camden, N. J., reports that this gasket has been on the market long enough to demonstrate its ability to meet the requirements of engineers. The joints have two concentric rings made from "Gladiator" asbestos metallic cloth, which are sustained by a metal ring, the verticle wall in the center of which forms a partition between them, and prevents their displacement by either steam or moisture. By this arrangement a double self-contained joint is made in place of the joint in ordinary use. These gaskets are sold in two forms: those made of "Gladiator" asbestos metallic cloth for the highest pressures, and those made of "Gladiator" millboard for dry steam, and for all joints where asbestos millboard is ordinarily used.

The Shelby Steel Tube Company, Pittsburg, Pa., has an exhibition of its product at the St. Louis fair, in the Transportation building.

The course in naval architecture of the New York Nautical College will be carried on during the summer months in the office of Mr. George Crouse Cook, naval architect and instructor, 52 Broadway, New York city.

"Sheet Packing," "Lubricated Valve Stem Packing," "Vulcabeston Air Brake Pump Rings," "Kearsarge Gaskets," "Hydro Water-Proof Hydraulic Packing," "Asbestos and Rubber-Wound Cloth Packing," and "How to Pack Gas Engine Cylinder Heads," are the titles of folders issued by the H. W. Johns-Manville Company, 100 William street, New York city.

A Marine Bucket.—Charles D. Durkee & Co., 2 South street, New York city, have accepted the agency for Crane's self-sinking galvanized marine bucket. This bucket, it is claimed, is immediately filled with water without dragging, upon lowering it from the side of a vessel. By means of a mechanical device concealed under the ear of the bucket it dives upon striking the water, and comes to the surface in an upright position.

Allis-Chalmers-Bullock, Limited, has taken over the Canadian business of the Bullock Electric Manufacturing Company, the Canadian Bullock Electric Manufacturing Company, Limited, the Allis-Chalmers Company, the Ingersoll-Sergeant Drill Company, the Lidgerwood Manufacturing Company, the Wagner Electric Manufacturing Company, and the Canadian Engineering Company, Limited. The head office and works will be in Montreal, Canada.

The Rhode Island Motor Company, Providence, R. I., reports the following sales: To Mr. S. O. Leavens, Providence, R. I., a 25-foot canoe-stern open launch, with a 6-H. P. Rhode Island motor; to Dr. T. H. Bell, Providence, a 25-foot canoe-stern cabin launch, with a 6-H. P. Rhode Island motor; to General Walker, Providence, a 25-foot cabin boat, with 6-H. P. Rhode Island motor; to Goff Brothers, Riverside, R. I., a 35-foot ferry boat, with a 9-H. P. Rhode Island motor.

"The Organization and Management of a Modern Steamship Company," was the subject of a lecture recently given by Mr. W. L. Guillaudeu, president of the Old Dominion Steamship Company, New York city, to the students of the School of Commerce, Accounts and Finance, New York university, New York city. We understand that copies of this lecture may be obtained from Mr. Richard R. Windon, traveling passenger agent of the Old Dominion line, 81 Beach street, New York city.

Staybolts for Norway.—The Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, has received an order from the Norwegian State Railway Company for Falls hollow and solid staybolt bars, this being the third order this company has received from the railway during the past year. A portion of the raw material from which the Falls staybolts are made is imported from Norway and Sweden and then blended with native charcoal iron, thus producing the required tensile strength and other requirements. The Falls Hollow Staybolt Company has also received orders from the governments of Japan and other foreign countries, and from the United States govenment.

Rules and Micrometer Calipers.—The L. S. Starrett Company, Athol, Mass., has received a letter from Mr. C. W. Crawford, of the Department of Physics, Lehigh university, South Bethlehem, Pa., in which Mr. Crawford says, speaking of some rules and calipers purchased by the university: "You may be interested to know the results of a test made upon the accuracy of the scales. I have already made a test upon one meter scale taken at random, and find by comparison with our standard meter that the error of your meter scale is not greater than 1000th of 1 per cent., the test being made at 15 degrees Centigrade. No greater degree of accuracy could be asked, and the workmanship of the tools is correspondingly good."

MARINE ENGINEERING
EMPLOYMENT BUREAU.

Full information regarding the purposes of this bureau, together with instructions regarding registration, etc., furnished upon application to Marine Engineering Employment Bureau, 309 Broadway, New York City.

All correspondence, concerning either vacancies or situations wanted, is strictly confidential.

MEN WANTED.

SHIPFITTERS, RIVETERS AND CAULKERS are wanted in a well-known shipyard. File 29.

CHIPPERS AND DRILLERS can find a position in a large shipyard if experienced. File 30.

SALESMAN FOR STEEL CASTINGS, both large and small, is wanted who understands steel casting business and who has acquaintance among purchasers. File 26.

SKILLED BOAT BUILDER who has had experience in handling men, and who can attend to the hull work in large launch works. File 14.

FOREMAN FOR BOAT BUILDING SHOP who has had experience in constructing new hulls, who can attend to repair work and is familiar with gas engines. File 15.

BOILER-SHOP FOREMAN. Must be familiar with various types of marine boilers and capable of handling repair work. Knowledge of shipbuilding and repairs will be of great advantage. File 10.

FORGINGS SALESMAN wanted who is acquainted with the manufacture and use of high-grade forgings, has had experience as a salesman and who has acquaintance in this special direction File 25.

MEN SEEKING POSITIONS.

We have applications registered for positions as follows, and the references of each applicant have been carefully investigated:

ASSISTANT SUPERINTENDENT, ENGINEER OR ASSISTANT ENGINEER IN ENGINEERING WORKS. Age 28; single; of English birth; has British and American licenses and has had several years' sea experience. Application No. 23.

CHIEF OR ASSISTANT DRAFTSMAN—ENGINE. Age 32; married; has had sea experience and several years' experience in government and private shipyards. Application No. 25.

CONSULTING ENGINEER AND NAVAL ARCHITECT. Married; born in Germany; had many years' experience in designing, drafting and surveying. Application No. 33.

DRAFTSMAN—HULL. Age 20; single; experienced in architectural work, but prefers marine drafting. Application No. 51.

DRAFTSMAN—HULL. Age 25; married; 9 years' experience in leading yards in drafting, testing materials, surveying, etc. Application No. 54.

DRAFTSMAN—HULL, OR INSPECTOR. Age 37; married; had experience both in government yards and private yards. Application No. 30.

DRAFTSMAN—HULL. Age 22; single; born in Norway; studied Technical schools in Norway and Germany; experience as draftsman, also as shipfitter. Application No. 31.

DRAFTSMAN—HULL. Age 25; single; born and educated in Germany; has had 7 years' experience in drafting, sea duty as engineer, and as shipfitter. Application No. 52.

DRAFTSMAN—HULL AND ENGINE. Age 26; single; graduated Webb Academy; has had four years' experience in navy yard work; desires connection with private shipyard. Application No. 41.

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" 2, Wm. Kelly, 11 Wall St., Cleveland, O.
" 3, A. L. Jones, 289 Champlain St., Detroit, Mich.
" 4, Jas. A. Macauley, 5802 Indiana Ave., Chicago, Ill.
" 5, Otto Boettger, 1035 E. Hopkins Ave., Baltimore, Md.
" 6, Wm. Arste, 322 Pine St., St. Louis, Mo.
" 7, Wm. T. McElwee, Box 1556, Portland, Me.
" 9, Wm. Bridges, 784 1-2 12th St., Milwaukee, Wis.
" 13, John G. Paulding, 1746 Tulip St., Philadelphia, Pa.
" 14, Joseph F. Dumas, 403 Dauphin St., Mobile, Ala.
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" 38, C. H. Wolford, 73 Starr Boyd Bldg., Seattle, Wash.
" 39, Frank Feeney, 460 E. 12th St., Erie, Pa.
" 40, Chas. Drouet, 1003 Ave. I, Galveston, Tex.
" 41, W. H. Marshall, 343 Holladay St., Portland, Ore.
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" 55, Archie Stalker, Box 883, Cheboygan, Mich.
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" 91, A. L. McLaren, 130 W. Walnnt St., Ashtabula, O.
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" 93, W. J. Cook, 2220 G. St., N. W., Washington, D. C.
" 94, Geo. R. Jones, Box 222, Washington, N. C.
" 95, P. J. McMahon, Box 199, Key West, Fla.
" 98, C. N. Vosburg, 323 Patton St., New Orleans, La.
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" 101, J. K. Cotton, Box 765, Norfolk, Va.
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TRADE PUBLICATIONS.

A United States consul in South America wishes MARINE ENGINEERING to secure for him all the information possible regarding the following subjects:

Freight steamers, single or twin screw, iron or steel hulls, carrying capacity 600 to 1,000 tons, very economical in the consumption of coal, having a maximum draft, when loaded, of not more than 9 or 10 feet, less preferably; also freight steamers of about 500 tons capacity with 6 or 7 feet draft.

Also passenger and freight boats from 500 to 1,000 tons capacity, with a draft of 6, 7, or 9 feet when loaded, speed of from 15 to 20 miles an hour, and to be very economical in the consumption of coal. The boats are to be of the sea-going type.

All correspondence can be addressed to United States Consul, care MARINE ENGINEERING, 309 Broadway, New York.

The "Perfection" reversing gear, manufactured by the William H. Brodie Company, 45 Vesey street, New York city, is described in an illustrated folder this company is distributing. The claim is made that this gear occupies small space, yet without sacrificing efficiency or strength; that the train of three grears is at all times in mesh, thus eliminating the possibility of stripping the teeth; that the gear is free of taper or clutch frictions; that the friction employed is a powerful expanding ring friction that may be adjusted at any time to accommodate any wear on the friction surfaces, and so arranged that it is impossible to become jammed, and is of such design that the most inexperienced operator cannot injure it. By throwing the lever on the center with the engine going, the screws and gears are at repose; while by throwing the lever forward the screw is driven ahead; and when thrown toward the stern the screw is reversed.

Modern cold storage, a reprint from "Ice and Refrigeration," is published in pamphlet form by the American Linde Refrigeration Company, 120 Liberty street, New York city. Illustrations and descriptions are given of refrigeration plants which this company has installed. The pamphlet states that the company has made a careful study of the carrying of perishable cargoes on board ship, and that it has designed special machinery to meet the requirements of shippers engaged in this trade. The system installed by this company allows the use of the refrigerating rooms for general cargoes at such times as refrigerated cargoes are not available. This system, so the pamphlet states, is used by the Canadian government and is installed on all the principal steamers plying between Europe and Canadian ports. It has also been adopted by the United Fruit Company and by the Northern Pacific Steamship Company on their new boats, the *Minnesota* and the *Dakota.*

Packings for marine and stationary engines are discussed in a pamphlet issued by the United States Metallic Packing Company, 427 North 13th street, Philadelphia, Pa. The pamphlet states: "We make a specialty of packing valve stems and piston rods on steam engines for all pressures and temperatures of steam. We have been making metallic rod packings for a quarter of a century, and have always manufactured them to meet the requirements of the times, and by this constant improvement have kept pace with modern steam engineering practice. United States packings are low in first cost, they are easily applied, and (with the exception of the babbitt metal rings), will last the life of the engine." The main success of this company's packing, so it is said, is due to its flexibility. No matter how badly an engine is of out of line or how much play there is between cross heads and girders, or between piston and cylinder, the United States packings will, the manufacturers claim, float with the rod, thus offering little resistance. The company makes a special provision for draining, and recommends its "Ideal" method of lubrication and draining.

When writing to advertisers please refer to MARINE ENGINEERING.

Graphite for axles is described and illustrated in a mailing card sent out by the Joseph Dixon Crucible Company, Jersey City, N. J. The company will send a free sample to any one addressing Department K.

Marine gas and gasoline engines and reversing clutches are illustrated and described in folders issued by the Holliday Manufacturing and Engineering Company, 160 Bunker street, Chicago, Ill. Regarding the reversing clutch, a folder states that the engine can be run forward all the time. "When the lever is set forward the propeller wheel moves the boat forward and the reversing gears are not in operation, consequently there is no noise. When set in another position the propeller wheel is reversed, and when set in a third position the propeller wheel is stopped. The movement of the lever is very slight and easily operated. Connection is made by sliding one or the other of the frictional hoods onto the frictional cone in the center. These parts are turned absolutely true and will slip in starting so that the power may be applied to the propeller gradually. The operator has perfect control of the propeller, as it may be started or stopped at will without reference to the engine. The reversing gears in the clutch are always in mesh but never in use except when the propeller is reversed, consequently there is no liability of breakage as connection is made."

Ship logs, range finders, and tell-tales, are illustrated and described in a catalogue issued by the Nicholson Ship Log Company, Cleveland, Ohio. Regarding the ship log the catalogue says: "The advantages claimed are (1) Accuracy. When adjusted to the ship, the log will run the distances as close as it is possible to steer the vessel, and will remain in adjustment an indefinite period, if intelligent care is given the apparatus. (2) It is entirely automatic and requires little attention beyond the daily winding of the clock and changing the paper record. Unless the harbor is very shallow no thought need be given to the log when making or leaving port. If the vessel is operated in shallow places, provision is made, while installing, to draw in the intake tube from the pilot house, or the sea cocks can be placed high enough on the bilge to prevent the fouling of the tube. (3) The registering apparatus is placed where it can be readily seen and read, usually in the pilot house, chart room, or on the bridge. If outside, a weather-proof case must be provided, in addition to that furnished with the log. (4) Being able to know at all times the exact speed of the vessel by simply glancing at the speed dial and also having this speed permanently recorded with the time and date on the record chart, the value of this record cannot be overestimated. In some instances the log has paid for itself many times over in preventing damage suits for alleged excessive speeds in dangerous passages. In a number of lines the masters are required to turn these records into the manager, who can see at a glance the whole performance of the ship while under way, and he files them for future reference."

GEORGE WASHINGTON'S example for telling the truth is being well perpetuated by

The Starrett High Speed Indicator

which tells the exact truth about a shaft's revolutions. The working parts of this Indicator are encased, and the dial plate has two rows figures, reading right or left, as the shaft may run.

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EVEN if you do not want to buy, it will pay you to write for our New Catalogue, No. 1.

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DIXON'S
GRAPHITE
PIPE JOINT
COMPOUND

Very Useful on Shipboard

Not only upon piping of all sorts, but upon bolts, nuts, caps, studs, etc. Threaded joints never rust or stick.

Write for new booklet 75-D, and free sample.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY N. J.

Thrust bearings and steel balls are described in an illustrated catalogue of fifty pages issued by the American Ball Company, Providence, R. I. In designing bearings the company's aim has been to construct self-contained bearings, made to conform to standard sizes and dimensions, to cover a wide field of work. The catalogue claims that ball bearings have certain advantages over roller bearings. Any one interested in the subject of anti-friction bearings should apply for a copy of this catalogue.

"What We Do" is the title of the latest catalogue issued by the Wellman-Seaver-Morgan Company, Cleveland, O. The interests of this combination are widely extended, covering most fields of industry in which steel is used. Among the subjects of particular interest to the readers of MARINE ENGINEERING are the following: "The construction of machine shops, the typical one being that at the South Chicago yard of the American Shipbuilding Company; cranes of all kinds, especially for handling freight, and in connection with ship and boiler works. The illustrations show cranes in the yard of the Fore River Ship and Engine Company as well as in a number of shops and on wharves. The variety of devices for loading and unloading vessels is well worth a careful investigation. There are also illustrated a large variety of hoists and other specialties.

A test of De Leval centrifugal pumps, consisting of standard centrifugal pumps direct connected to De Leval steam turbines, has just been made by Messrs. J .E. Denton and William Kent. The results of these tests are published in bulletin form and copies can be had by applying to the De Leval Steam Turbine Company, Trenton, N. J. The bulletin comprises twenty-four pages and the text shows that the tests were very thorough. In the back part of the bulletin are illustrations of the De Leval turbines connected to electric generators, Sturtevant blowers, etc.

Cold saw cutting-off machines are illustrated and described in Catalogue 39, issued by the Newton Machine Tool Works, Philadelphia, Pa. The catalogue states: "All of our tools have recently been re-designed, and these machines are of the construction which our experience with over 1,200 has demonstrated to be the best. They range from our small bar saw, with a capacity of two inches, up to our large machine for engine cranks and forged stock, having a capacity of 21 inches. The different machines illustrated are adapted to the cutting of round and square stock, I-beams, channel bars, armor plate, nickel steel and gates, or risers on steel castings. The spindles on the different designs are driven either direct or through gearing by phosphor bronze worm steels and hardened steel worms of steep lead; they have automatic feed, and with the exception of the three small sizes of bar saws, have power of quick return to carriage. The feed clutch has an automatic throw-out."

Centrifugal pumps, double-suction pumps, and vertical steam engines, are illustrated and described in a very complete catalogue of 56 pages issued by the Lawrence Machine Company, Lawrence, Mass. Regarding the pumps, the catalogue states that the Lawrence pumps have been in successful operation for twenty years, thus demonstrating the correctness of the principles upon which they are designed and the high class of the material used in their manufacture. The claims are made that these pumps may be erected with ease and celerity, that they work with an easy rotary motion, without valves or eccentrics; that they will discharge a great quantity of water in proportion to the power expended; that they are economical in use, simple in construction, and of great durability; that they discharge a continuous stream of water without air chambers; that their cost, measured by the amount of water discharged, is very low; that they are little effected by sand, mud or other substances; that they will pump hot or cold liquids equally well; and that they require a very light and inexpensive foundation. This company designs engines for use in connection with its pumps, as well as engines suitable for other auxiliary purposes. Anyone interested in the subject of pumps for dry-docks, for dredging purposes, for circulating water in surface condensers, in bilge pumps on steamships in connection with syphon condensers; for pumping out coffer dams, or manufacturing plants of any kind, should not fail to send for a copy of this catalogue.

Walworth Mfg. Co., 130-136 Federal St. BOSTON
N. Y. Office, Park Row Bldg.

Specialty of **BRASS VALVES** and Fittings for Marine Construction

Extra Heavy Valves, Bent Pipe and Fittings for High Pressure Work

SOLE MANUFACTURERS OF
WALWORTH FLANGED—OVER PIPE JOINT
Which does not Weep under heavy pressure

OUR BOOK CONTAINING "TABLES OF DIMENSIONS" OF WALWORTH GATE VALVES, FLANGED FITTINGS, FLANGED OVER PIPE JOINTS, WROUGHT IRON BENDS, ETC., should be in your draughting room.

The Knowles express pump is the subject of Bulletin K-73, issued by the Knowles Steam Pump Works, 114 Liberty street, New York city. This pump is of the reciprocating type and is direct-connected to an electric motor. A 250-gallon pump is said to run at a speed of 300 revolutions per minute.

"Triplex" chain blocks for warehouse use are described and illustrated in a folder issued by the Charles A. Strelinger Company, Detroit, Mich. The folder states that by the use of these blocks it is possible to tier material up to the ceiling, doubling the capacity of floor space. A catalogue and a block for thirty days' trial will be sent upon application to readers of MARINE ENGINEERING.

Cockerill gas engines are illustrated and described in a catalogue issued by the Wellman-Seaver-Morgan Company, Cleveland, O., the American licensees of these engines. The catalogue states that the Cockerill engines are of the four-cycle type. The engine acts as a pump as well as a motor, the gas mixture being drawn in during the first stroke, compressed during the second stroke, exploded in the third, and exhausted in the fourth stroke. These engines are made with one, two, or four cylinders, either single, tandem, or twin-tandem.

The July issue of *The Progress Reporter*, published by the Niles-Bement-Pond Company, manufacturers of machine tools, 136 Liberty street, New York city, states that the company's machines exhibited in Sections 17 and 25, Palace of Machinery, World's Fair, St. Louis, are either of entirely new design or embody radical modifications of older patterns. All of the larger machines are driven by direct-connected motors. The more important machines are illustrated and described in this issue of *The Progress Reporter*, a copy of which will be sent to any reader of MARINE ENGINEERING upon application.

Steam pumps are the subject of a 96-page illustrated catalogue issued by the Warren Steam Pump Company, Warren, Mass. A great variety are described, among which are single-boiler feed or pressure pumps, single light-service pumps, piston pattern, single plunger pumps, hydraulic-pressure pumps, vertical sinking pumps, vertical wrecking pumps, deep-well pumps, single-cylinder power pumps, duplex power pumps, duplex pumps, separate cylinder style with plain valve gear, underwriter fire pumps; and, in fact, steam pumps for almost every service. At the end of the book are useful tables of areas of circles, pressures of water for varying heights, contents of cylinders in cubic feet, friction loss in pounds pressure per square inch, temperature and weight of steam at different pressures, etc.

Cold saw cutting-off machines are illustrated and described in Catalogue No. 25, issued by the Diamond Drill & Machine Company, Birdsboro, Pa., manufacturers of rolling mill and hydraulic machinery, diamond prospecting drills, Jackson belt-lacing machines, automatic saw-sharpening machines, air furnaces and cupola castings, open-hearth steel castings, and heavy or light machinery of all kinds. Regarding the cold saw cutting-off machines, the catalogue states that each type is built in seven sizes, with beds to suit all requirements. The company has secured the sole rights to manufacture and sell the Wagner cold saw cutting-off machines and automatic saw sharpeners in the United States and Canada. Among the advantages claimed for the cutting-off machines are great capacity for speed, minimum wear of saw blades, automatic feed, according to variation in shape or hardness of material to be cut, every tooth of saw brought into action by means of counter-balanced feed, automatic indication of dull saws, no cessation of cutting even in case of saws with broken teeth, automatic throwing out of feed when cut is completed, thus allowing one operator to have charge of several machines, counter shafts not required, rigid and simple construction, head swivels—cuts any angle, saw can be used in horizontal position.

A Boat Painted White

with ***Oxide of Zinc*** will remain white in all seas and all climates; and tints based on ***Oxide of Zinc*** will remain pure and unaltered. There is no other satisfactory white pigment for marine service.

OUR PRACTICAL PAMPHLETS FREE:

"The Paint Question,"
"Paints in Architecture,"
"French Government Decrees,"
"Specifications for Architects,"
"Paint: How, Why and When."

THE NEW JERSEY ZINC CO.
71 BROADWAY
NEW YORK

We do not grind zinc in oil. List of zinc paint manufacturers is furnished on request.

CONDENSER TUBES

last longest if made of

"BENEDICT-NICKEL"

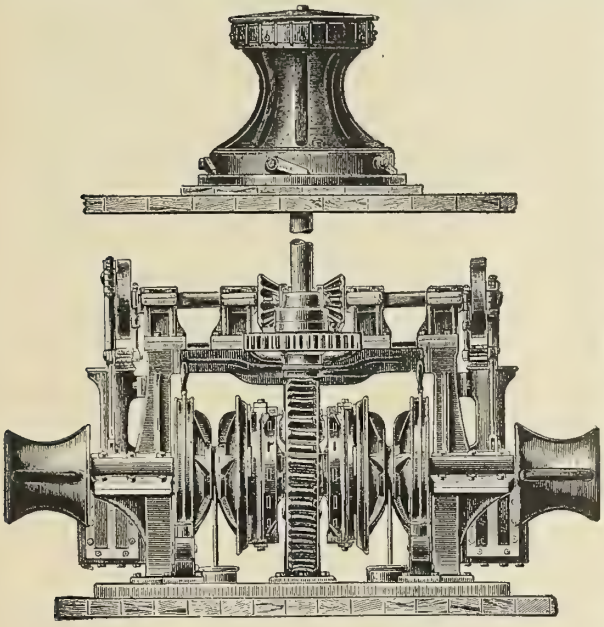
ELECTROLYSIS is positively resisted because "Benedict-Nickel" is an alloy of nickel and copper.

CORROSION is impossible, as the tubing is so perfectly homogeneous.

Our treatise on "Electrolysis of Condenser Tubes" is very valuable and costs you nothing. Send for it.

BENEDICT & BURNHAM MFG. CO.
WATERBURY, CONN.
New York, 253 Broadway Boston, 172 High St.

STEERING GEAR
WINDLASSES, CAPSTANS



AND OTHER SHIP AND YACHT FITTINGS

The Textile-Finishing Machinery Co.

17 EXCHANGE PLACE, PROVIDENCE, R. I.

NEW YORK OFFICE, 39 CORTLANDT STREET

Tangential water wheels is the title of a booklet issued by the Abner Doble Company, San Francisco, Cal. There are many illustrations and the booklet contains much information of interest to users of water wheels.

Drop forgings and machinists' tools are illustrated and described in a 120-page catalogue issued by the Billings & Spencer Company, Hartford, Conn. This is a very complete catalogue and should be in the hands of every machinist. Wrenches of many styles and sizes, combination pliers, wire cutters, drop-forged carbon tongs, ratchet drills, taper sleeves, drop-forged lathe dogs of many varieties, machinists' clamps, reamer holders, thread cutting and diamond point lathe tools, screw-plate surface gauges, caliper gauges, boiler makers' hammers, gun and machine makers' screw drivers, belt fasteners, drop-forged weldless eye bolts, and drop hammers, are among the tools described in this catalogue. The Billings & Spencer Company also makes special drop forgings to order.

"A. B. C." disc fans, direct connected to Westinghouse motors, are illustrated on a mailing card distributed by the American Blower Company, Detroit, Mich.

The use of producer gas in connection with suction gas engines is proving very satisfactory in Germany and other European countries. One of the leading concerns in this country which manufactures producer-gas outfits is R. D. Wood & Co., 400 Chestnut street, Philadelphia, Pa. This company is now distributing a well-printed and illustrated catalogue entitled "Gas for Power and Fuel, One Horse Power, One Hour, One Pound of Coal." The plants described are for industrial uses, but by slight modification can be adapted to marine uses, hence the catalogue is one that will be of much interest to all those of our readers who are concerned in gas engines.

Friction clutches are illustrated and described in a catalogue issued by the Carlyle Johnson Machine Company, 356 Asylum street, Hartford, Conn. The catalogue states that these clutches embody all the principles which make a perfect friction clutch; that they are simple, powerful, neat, and operate easily and quietly; that they have few parts, and these interchangeable; that they are round and smooth, with no protruding parts, thus making accidents impossible; that there are no bolts, nuts, links, etc., to become loose and cause trouble; that one screw adjusts them to any required tension; and that the working parts being entirely covered, are free from dirt.

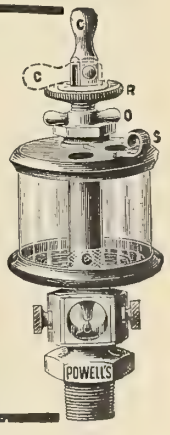
Concrete construction is the title of an illustrated pamphlet issued by the Engineering Company of America, 74 Broadway, New York city. This book is a discussion of the advantages of concrete construction in building sea walls, breakwaters, piers, factories, warehouses, bridges, dust chambers, stand pipes, office buildings, etc., and except for the advertisement on the last page contains no reference to the Engineering Company of America. The pamphlet gives details of the Baltimore fire, and extracts from the reports of engineers showing that "when floor arches and steel coverings were of concrete, they stood the test much better than terra cotta." Any one interested in this subject should send for a free copy of the booklet.

Uses of flake graphite on shipboard is the subject of an illustrated article by Mr. H. E. Raabe, M.E., in the August number of *Graphite*, published by the Joseph Dixon Crucible Company, Jersey City, N. J. The article deals particularly with the lubrication of stern bearings and the bracket bearings of a twin-screw hydraulic dredge. Separation of graphite from exhaust steam is also discussed in this number of *Graphite*. The article states: "Any separator or grease extractor or filter that will remove cylinder oil from exhaust steam will remove every trace of graphite. We have been informed by a marine engineer of great experience that the action of graphite in a surface condenser is to greatly reduce the electrolytic corrosion of the tubes. If graphite gets into a boiler it will be found that it will make the boiler scale much more friable and less tenacious."

POWELL'S PATENT "SIGNAL" OILER

SIGNAL LEVER UP—FEEDING
SIGNAL LEVER DOWN—FEEDING STOPPED

Easy to fill. Simple to regulate. The only Oiler on the market with sight chamber that can be examined and cleaned without interfering with the operation of the cups.



THE WM. POWELL CO.

Everything in the steam line for the boiler and engine room.

Send for Complete Illustrated Catalogue.

CINCINNATI, OHIO, U. S. A.

New York Agent:
H. H. BEALS, 51 Cliff Street

Philadelphia Agent:
C. J. RAINEAR & CO., 518 Arch Street

Measuring tapes, rules, etc., are described in Catalogue 7, issued by the Lufkin Rule Company, Saginaw, Mich. This catalogue is profusely illustrated, and describes at length linen and steel measuring tapes, rules, and other engineers' supplies, embodying a great variety of styles, suitable for almost any use required by engineers and draftsmen. A free copy will be sent upon application.

The condensing apparatus manufactured by the Alberg Condenser Company, 95 Liberty street, New York city, is illustrated and described in a booklet the company is mailing. Among the articles this company makes are jet condensers, surface condensers, barometric condensers, central condensers, self-cooling condensers, Corliss dry vacuum pumps, centrifugal and direct-acting pumps, and cooling towers.

Gas for power and fuel is the title of a catalogue sent out by R. D. Wood & Company, engineers, iron founders, and machinists, Philadelphia, Pa. Triple-expansion condensing pumping engines, hydraulic fixed and portable riveters, hydraulic forging and bending machinery, hydraulic cranes, and other machine tools used by ship, engine, and boiler makers, are also illustrated and described in this catalogue.

Marine life-saving and fire-fighting appliances are illustrated and described in a pamphlet issued by the James Reilly Repair and Supply Company, 229 West street, New York city. Ring buoys, life preservers of various types, rubber hose, fire axes, fire extinguishers, metallic cylinder life rafts, United States regulation metallic life boats, and double-acting brass ship deck pumps, are among the articles described in this pamphlet.

Air ports, dead lights, deck lights, ventilators, coaling scuttles, manhole plates, etc., are described in Catalogue A, issued by the Marine Manufacturing and Supply Company, 157 South street, New York city. This company manufactures and deals in all kinds of vessel fittings, marine and heavy hardware, hoisting apparatus, derrick fixtures, tackle blocks, cordage, chains, anchors, flags and signals, buoys, life preservers, paints, oils, varnishes, brass and iron castings, machine work, blacksmithing, and brass finishing.

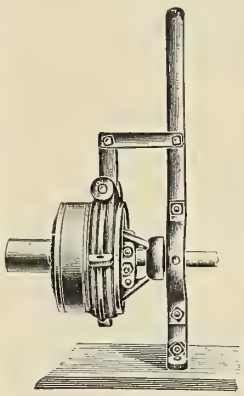
Barton steam generators are thoroughly illustrated and described in the 1904 catalogue issued by the Barton Boiler Company, 4212 State street, Chicago, Ill. This outfit consists of a steam boiler of the flash type, which is thoroughly described. The burner is a special type designed for the use of kerosene. This plant was originally designed for use in automobiles but has now been adapted by the company for small and compact power plants for launches, having been recently approved by the Steamboat Inspection service. Any one interested in this subject of small steam plants for use in launches will find this catalogue very interesting.

Users of marine and field glasses will be interested in a tiny book published by the Warner & Swasey Company, Cleveland, O. The booklet states that the old type of field glass usually magnifies four or five diameters and never more than six diameters, while the Warner & Swasey glasses magnify from six to ten diameters. Moreover, the old style of glass is said never to have a field of view larger than four degrees, while the lowest power of Warner & Swasey glasses has a field view of six and three-quarters degrees. How much this means will be understood after seeing in this book the pictures of a light house, showing the field of vision looking through the old type of glasses and through the Warner & Swasey glasses.

THE IMPROVED

"BALL" REVERSE GEAR

FOR MOTOR BOATS



THE BALL REVERSE GEAR.

MADE ONLY OF

SPUR GEARS

PATENTED,
April 9, 1901.
Nov. 3, 1903.
Jan. 12, 1904

HAS NO EQUAL

Manufactured Only by the

NEW YORK GEAR WORKS

56 Greenpoint Ave., Brooklyn, N. Y.

Send for Catalogue.

Combination Book Offer...

Practical Marine Engineering, - - $5.00
Gas Engines and Their Troubles, - - 1.50
Total, $6.50

PRICE OF THE TWO, $5.75

Sent on receipt of price by

Marine Engineering, 309 Broadway, New York City

Gold dredging machinery and sand pumps are illustrated and described in Catalogue No. 2, issued by the General Construction Company, Marion building, Seattle, Wash.

The Mason Regulator Company, 158 Summer street, Boston, Mass., is mailing a price list of repair parts for all sizes of Mason reducing valves. A copy of this list with be mailed free upon application.

Steering gears, steering wheels, port lights, deck plates, yacht bells, diaphragm pumps, hydraulic pile-sinking outfits, bilge and deck force pumps, manufactured by the Edson Manufacturing Company, 255 Atlantic avenue, Boston, Mass., are brought to the notice of the public by a mailing card which this company is distributing.

Second-hand machine tools, for sale by the Garvin Machine Company, Spring and Varick streets, New York city, are listed in a folder now being distributed by the company. Full description of any machine listed will be sent upon application, together with photographs whenever possible.

The Muller slot-punching device is the subject of a folder issued by Martin Eriksson, Station B, Box 104, Cleveland, O. The folder states that this device produces in a single operation a perfectly smooth-edged, straight, curved, or broken slot; thus doing away with all clipping and hand work. The device may be applied to any standard punching machine already in use.

UNITED STATES METALLIC PACKINGS

RELIABLE—SATISFACTORY—EFFICIENT

FOR PISTON RODS AND VALVE STEMS OF MAIN AND AUXILIARY ENGINES

The United States Metallic Packing Co.

427 North Thirteenth St., PHILADELPHIA. CHICAGO, 509 Great Northern Bldg.

BUSINESS NOTES.

Babcock & Wilcox boilers in the British navy.—It is announced that after four years of investigation the boiler committee appointed by the British admiralty has unanimously declared in favor of water-tube boilers for naval use, and has placed the boilers made by the Babcock & Wilcox Company, New York and London, at the head of the list.

The Lyle life savers' gun.—Regarding this gun, the agent, James Reilly Repair and Supply Company, 229 West street, New York city, says: "Hitherto it has been the custom to project the line from the shore to the vessel, and under the conditions which usually exist, this is a matter of great difficulty. The advantages, therefore, of shooting the gun from the ship to the shore, which is the purpose of the Lyle gun, are obvious. This gun is the same as used by the United States life saving stations. It may also be used for saluting."

Decision regarding electrical instruments.—On advertising page 13 our readers will find an announcement of a court decision in favor of the Weston Electrical Instrument Company, Waverly Park, Newark, N. J., in a suit brought by that company for an infringement of its patents.

The steam yacht Arrow, owned by Mr. Charles R. Flint, New York city, has proved to be very speedy. On July 18 there was a race between the *Arrow* and the new Sandy Hook steamer *Asbury Park,* which is the fastest boat in the fleet. The *Asbury Park* left her dock at the foot of Rector street, and the *Arrow* started after her, passing the dock eight minutes later. The *Arrow* soon overhauled and passed her, continuing on to the *Asbury Park's* dock at the Highlands, arriving there twenty minutes ahead of the *Asbury Park,* thus beating that boat twenty-eight minutes, and making the run of 20 1-2 miles in fifty minutes. The original designs of the *Arrow* were made by Mr. C. D. Mosher, 1 Broadway, New York city.

RESULTS PROVE IT!

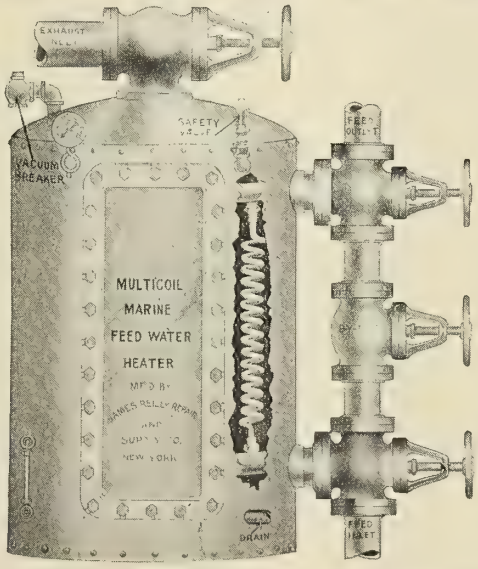
Let Us Prove It to You—
As We Have to Others Who Pay for the Coal.

Our Multicoil Feed-Water Heater
IS A SUCCESS

IF YOU CANNOT KEEP UP STEAM
IF YOU CANNOT MAKE TIME
IF YOU CANNOT DEVELOP H. P.
} *OUR HEATER WILL HELP YOU*

A FEW VESSELS THAT HAVE THEM:

Monroe,
Jamestown,
Hampton Roads,
Horatio Hall,
North Star,
Middletown,
Manhattan,
Kershaw,
Powhattan,
Juniata,
Essex,
Chatham,
D. H. Miller,
Admirals Sampson and Schley,
Lighter Edgewater,
The Four New Lackawanna R. R. Ferryboats.



Asbury Park,
Sandy Hook,
Henry Wilson,
Sprigg Carroll,
Calvin Austin,
Patrol,
General Meigs,
Yachts: Celt, Carmina, Calumet, Waturus and Pioneer.
Dredges: Atlantic, Pacific, Perry, Caucus, St. John.
Government Dredges: 43, 44, 45, 46, 47, 51.

ASK US FOR A CATALOGUE.

THE JAMES REILLY REPAIR & SUPPLY CO.

229-233 WEST STREET, - - - NEW YORK CITY

NAVY DEPARTMENT ORDERS WRECKING PUMPS.—The Lawrence Machine Company, Lawrence, Mass., has received a contract from the United States Navy Department for three centrifugal wrecking pumps, ranging in capacity from 20,000 to 40,000 gallons per minute; each pump to be direct-connected to Lawrence engines, and each arranged so that electric motors may be substituted in place of the engines.

WILL ERECT A ROLLING MILL.—The Victor Metals Company, 29 Broadway, New York city, which manufactures Victor non-corrosive silver metal, Victor bronze, manganese bronze, Azalea anti-friction metal, phosphor and aluminum bronze, and bell and electric metals, has found it necessary to build a rolling mill, on account of the great increase in the demand for its metals. The company asks for catalogues of rolling mill machinery and furnaces.

CHAPMAN VALVES AT THE ST. LOUIS EXPOSITION.—The Chapman Valve Manufacturing Company, Indian Orchard, Mass., has a working exhibition at the fair, as the power plant in the Machinery Building and the boiler house adjacent are equipped exclusively with this company's valves, including several 24-inch electrically-operated and automatically-controlled valves in the condenser apparatus piping. The Chapman electrically-operated valves are also exhibited in connection with the General Electric Company's display, Block 28, Palace of Electricity.

BAGS OF GOLD GIVEN AWAY.—James L. Robertson & Sons, 204 Fulton street, New York city, manufacturers of Eureka packing, Robertson-Thompson indicators, and many other steam specialties, in their desire to keep themselves and their goods before the public, started in February last a guessing scheme, offering three prizes, $200, $75, and $25 in gold to the engineers who guessed nearest to the number of admissions to the St. Louis exposition on July 4. Naturally there were a great number of contestants. On receipt of the official figures from the secretary of the exposition, 179,258, a committee composed of the publishers or managers of the five engineering papers examined the records and awarded the prizes as follows: Joseph Carson, engineer, Pennsylvania Railroad Company, Newark, N. J., who guessed 178,986, first prize; Mason Chilcote, engineer, American Sewer Pipe Company, Akron, O., who guessed 179,738, second prize; Albert Smith, engineer, American Multiple Fabric Company, Providence, R. I., who guessed 180,210, third prize. The gold has been forwarded to these engineers.

PHOENIX METAL FOR BEARINGS.—Mr. Dan. E. Lynn, general marine sales agent, National Lead Company, Cleveland, O., has received many letters of commendation regarding the Phœnix metal, which the National Lead Company manufactures. The chief engineer of the Lehigh Transportation Company writes: "We used the Phœnix metal on two of our ships last season and it has given perfect satisfaction. We are now putting it in the crank-pin journals of two of our largest ships, the *Mauch Chunk* and *Wilkesbarre*. The engineers report that the wear on the journals fitted with the Phœnix metal is much less than that on the brass formerly used." Mr. W. G. Jenks, treasurer of the Jenks Shipbuilding Company, Port Huron, Mich., writes: "We have put Phœnix metal into the main journals, thrust bearings, and crank-pin boxes of the steamers *Capt. Thomas Wilson, Kennebec, Charles S. Neff, Henry Steinbrenner,* and *Kanawha*. We are also putting it into the engines of the United States lighthouse tender *Hyacinthe* and the steamer *John B. Cowle*. The steamers *Wilson, Steinbrenner,* and *Cowle* are 440 feet long and have a capacity of about 6,300 gross tons. The steamer *Wilson,* the past season, has beaten every steamer she has come across. We have yet to hear the first complaint of this metal, and, until we do, we shall continue to use it in all of our large engines, and we can cheerfully recommend it to anybody who wants a first-class metal."

MARINE ENGINEERING
EMPLOYMENT BUREAU.

Full information regarding the purposes of this bureau, together with instructions regarding registration, etc., furnished upon application to MARINE ENGINEERING Employment Bureau, 309 Broadway, New York City.

All correspondence, concerning either vacancies or situations wanted, is strictly confidential.

POSITIONS SEEKING MEN.

BOILER-SHOP FOREMAN. Must be familiar with various types of marine boilers and capable of handling repair work. Knowledge of shipbuilding and repairs will be of great advantage. File 10.

CHIPPERS AND DRILLERS can find a position in a large shipyard if experienced. File 30.

FOREMAN FOR BOAT BUILDING SHOP who has had experience in constructing new hulls, who can attend to repair work and is familiar with gas engines. File 15.

FORGINGS SALESMAN wanted who is acquainted with the manufacture and use of high-grade forgings, has had experience as a salesman and who has acquaintance in this special direction File 25.

SALESMAN FOR STEEL CASTINGS, both large and small, is wanted who understands steel casting business and who has acquaintance among purchasers. File 26.

SKILLED BOAT BUILDER who has had experience in handling men, and who can attend to the hull work in large launch works. File 14.

STEAMFITTER AND COPPERSMITH acquainted with plumbing, and able to make estimates; also to take charge in a general way of plumbers, coppersmiths and steamfitters. File No. 36.

SUPERINTENDENT, DESIGNER AND FOREMAN wanted in a shop devoted to the building of small pleasure boats. File No. 35.

ACTIVE AND PRACTICAL SUPERINTENDENT fo yacht, launch and boat-building works wanted. One who can take a financial interest in the business preferred. Good opportunity to become associated with a growing business in which all interested are working. File No. 38.

MEN SEEKING POSITIONS.

We have applications registered for positions as follows, and the references of each applicant have been carefully investigated:

ASSISTANT SUPERINTENDENT, ENGINEER OR ASSISTANT ENGINEER IN ENGINEERING WORKS. Age 28; single; of English birth; has British and American licenses and has had several years' sea experience. Application No. 23.

BOILER-SHOP FOREMAN. Age 35; single; many years' experience in Navy Yard and leading shipyards. Application No. 59.

CHIEF OR ASSISTANT DRAFTSMAN—ENGINE. Age 32; married; has had sea experience and several years' experence in government and private shipyards. Application No. 25.

CONSULTING ENGINEER AND NAVAL ARCHITECT. Married; born in Germany; had many years' experience in designing, drafting and surveying. Application No. 33.

DESIGNER AND DRAFTSMAN. Has had many years' experience in launch and river boat work. Designed some of the fastest river boats in the country. Application No. 61.

DRAFTSMAN, ENGINE AND BOILER. Age 30; unmarried; has Danish marine license; technical school graduate. Application No. 57.

DRAFTSMAN—HULL. Age 20; single; experienced in architectural work, but prefers marine drafting. Application No. 51.

DRAFTSMAN—HULL. Age 25; married; 9 years' experience in leading yards in drafting, testing materials, surveying, etc. Application No. 54.

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12 West 31st Street, New York.

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Secretary-Treasurer, W. J. BAXTER.
Executive Committee, LEWIS NIXON, EDWIN A. STEVENS, HARRINGTON PUTNAM, STEVENSON TAYLOR. *Ex-officio*, FRANCIS T. BOWLES, W. J. BAXTER.

AMERICAN SOCIETY OF NAVAL ENGINEERS.
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" 100, Jas. P. Lynch, Honolulu, H. I.
" 101, J. K. Cotton, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., South Haven, Mich.
" 103, A. E. Pittman, Box 378, New Bern, N. C.

TRADE PUBLICATIONS.

The Richmond Electric Company, Richmond, Va., is distributing Bulletin No. 2, describing this company's moderate-speed motors.

Graphite as a lubricant is scientifically and practically considered in a booklet which is being distributed by the Joseph Dixon Crucible Company, Jersey City, N. J. This is the eighth edition of this booklet, which explains the manifold uses of graphite in connection with steam and power plants.

Marine thermometers and other instruments.—A complete catalogue, describing the marine thermometers, gauges, and other high-grade instruments, manufactured by the Hohmann & Maurer Manufacturing Company, Rochester, N. Y., is now in press, and copies will be ready for distribution in a short time. Any of the readers of MARINE ENGINEERING who are at all interested in the subject, and every up-to-date engineer should be, ought to be sure to have a copy forwarded as soon as it is ready for distribution.

Users of gas engines for marine purposes, will find much interest in a catalogue issued by the Dayton Electrical Manufacturing Company, Dayton, Ohio, entitled "Apple Ignition Apparatus." The apparatus described is not merely for purposes of furnishing sparking outfits, but also for compact lighting plants. These include a dynamo operated direct from the engine and used in connection with small lamps, compact switchboard, and storage batteries. Every launch builder and owner may have a copy of this catalogue sent free by mentioning MARINE ENGINEERING.

The steam pumps and other specialties manufactured by the Dean Bros. Steam Pump Works, Indianapolis, Ind., are finely illustrated and concisely described in Pony Catalogue No. 44. A paragraph at the top of the first page states that these works have the largest and most complete line of steam pump patterns in the country, and that this catalogue contains descriptions of but a few. Any reader of MARINE ENGINEERING who is at all interested in the subject of pumps and other marine auxiliaries, and who wishes any special information, should apply direct to the company for more detail than that given in this catalogue, if it is desired.

A free copy of an excellently printed and very complete catalogue of 136 pages, will be sent by Annin & Company, 99 Fulton street, New York, N. Y., giving a great deal of information regarding the flags, banners, and other specialties of this firm. The catalogue contains large pictures in color of various styles and sizes of flags, with pennants, signals, etc., of all kinds, flags of all the nations of the world printed in colors, and many pages are devoted to different styles of burgees, club flags, special yacht flags, etc. There are also several pages of patriotic novelties, together with a variety of other specialties connected directly or indirectly with patriotic demonstrations, and flags, colors, etc., used in connection with vessels of all kinds.

The Mosher water-tube boiler, both the marine type and the stationary, will be found illustrated and described quite exhaustively in folders which are being distributed by the Mosher Water Tube Boiler Company, 1 Broadway, New York city. There are four folders as follows: first, "Official Test of the Mosher Boiler on the Monitor *Florida*"; this contains a fine picture of the monitor, and gives interesting comparison of tests made of different types of boilers on war vessels. Second, "The Type B Boiler," which is illustrated both externally and with sectional views, and contains details regarding dimensions, weights, horse power, etc. A third circular, contains thirteen pictures of torpedo boats and destroyers, as well as of steam yachts, which have been equipped with Mosher boilers. Among these pictures are fine ones of the *Arrow*, "the fastest vessel in the world." The fourth folder describes the stationary boiler.

"Graphite Afloat and Afield" is one of the latest publications of the Joseph Dixon Crucible Company, Jersey City, N. J. In this booklet is a concise description of many of the graphite preparations manufactured by the Dixon Company, especially for use on yachts, launches, row boats, fishing rods, rifles, etc.

Insulating materials.—The H. W. Johns-Manville Company, 100 William street, New York city, has issued a neat and complete catalogue covering "Mica" plate, cloth, segments, rings, and mica in all its various forms required by the electrical industry; also "Vulcabeston," "Transite," "Electrobestos," and "Niagrite." A copy can be had upon application.

Well-illustrated circulars are being distributed by the Baum Separator & Machine Company, 39 Cortlandt street, New York city, describing the Baum oil separator, which is also fully illustrated by half-tone engravings and line drawings of sectional views. There are also tables of dimensions, sizes, etc.

Engines and boilers for stationary plants, made by James Leffel & Company, Springfield, Ohio, are illustrated and described in a catalogue distributed by the company. The catalogue enters into details as to the making of Leffel engines and boilers, and shows on what facts their alleged superiority is based. The book will be mailed free to prospective buyers of stationary engines and boilers.

"Metal-Working Machine Tools" is the title of the latest catalogue issued by the Garvin Machine Company, Spring and Varick streets, New York city. It is only 4 by 6 inches in size and is printed on very thin paper, so that there are 274 pages of text, yet the catalogue is scarcely half an inch in thickness. Every reader of MARINE ENGINEERING, by mentioning this magazine, can have a copy sent free upon application.

"Speaking of Pumps" is the title of a folder issued by the Barr Pump Company, Lehigh avenue and 18th street, Philadelphia, Pa. The Barr pumps are stated to be very thorough in construction. The plungers travel through bronze bushings bored with annular grooves for water packing. The water valves are located below and above the plungers, giving the water a straight course up and down through the two sets of valves. The valve areas are unusually large and water passages are correspondingly liberal in size.

Portable drilling machinery is the subject matter of the latest catalogue issued by the Thomas H. Dallett Company, York street and Sedgley avenue, Philadelphia, Pa. It contains 44 pages and is devoted entirely to the different types of portable drills and boiler-shell drills which this company manufactures. There are probably thirty large-sized illustrations showing different types of drills and applications of them, so that altogether the catalogue is one which must of necessity be of practical value to any one who has to do with drilling for deck use of hand or other power.

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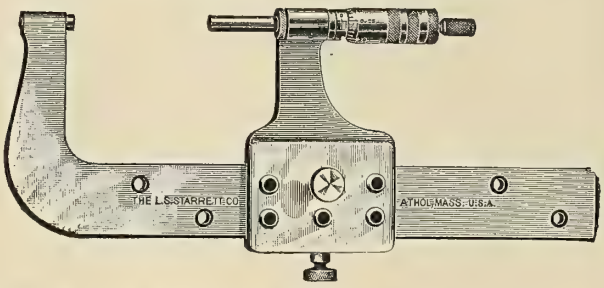
Six Inch Micrometer

will measure round work to 4½ inches and flat work to 6 inches. It weighs 21 ounces and is rigid and accurate.



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is a story of an unconventional love match, well told and beautifully illustrated. As a bit of readable fiction the story is well worth writing for. It is contained in a handsomely bound book of 128 pages, a portion of which is devoted to the attractive mountain and lake resorts along the Lackawanna Railroad. It is a book you will like to see. It may be had by sending 10 cents in postage stamps to T. W. Lee, General Passenger Agent, Lackawanna Railroad, New York.

NEW CATALOGUE FRESH FROM THE PRESS—ASK FOR IT.

THIS SPACE is too limited to give any idea of our splendid line of

Marine Engineering Thermometers and Gauges

Our New Catalogue No. 1 tells all and it's well worth asking for.

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Very Useful on Shipboard

Not only upon piping of all sorts, but upon bolts, nuts, caps, studs, etc. Threaded joints never rust or stick.

Write for new booklet 75-D, and free sample.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N. J.

The air compressors, both stationary and portable, manufactured by the National Electric Company, Milwaukee, Wis., are described in Bulletin No. 350.

The subject of lubrication is interestingly and thoroughly handled in a 32-page booklet, describing the Uneo asbestos grease manufactured by the Lubricating Company, General, corner Chestnut and Broad streets, Philadelphia, Pa. Among the many testimonials published are several from steamship lines, especially from engineers on several ships of the Earn line.

The Brooks centrifugal pump is fully described in a catalogue distributed by William H. Cook & Company, 752 Monadnock Block, Chicago, Ill. In addition to a full description of the pump, and illustrations showing its peculiar design, there are drawings giving sectional views and details of the construction of the pump, so as to explain fully why the pump is claimed to be so efficient.

Round-type motors, direct current, are described in Bulletin No. 219, which is now being distributed by the Sprague Electric Company, 527 West 34th street, New York city. It comprises 16 handsomely-printed pages fully illustrated. In addition to the description of the motor in detail there are a dozen or more pictures showing applications of the motors to presses, ventilators, lathes, and other types of machinery.

The latest biographical sketch issued by Wyman & Gordon, Worcester, Mass., is entitled "A Short Story of Kristofer Polhem."

Yachtsmen and others interested in the subject of sails, awnings, flags, tents, etc., will want to send for a pocket-size catalogue issued by the J. C. Goss Company, 10 Atwater street, East, Detroit, Mich. It contains 76 pages.

The Keuffel & Esser Company, 127 Fulton street, New York city, is distributing a circular of interest to draftsmen, describing the Keuffel & Esser automatic print hanger.

The Branden rubber pump valve is briefly illustrated and described in a four-page folder which is being distributed by the Crosby Steam Gauge and Valve Company, Boston, Mass.

What will be done with exhaust steam, a question for engineer and owner, is discussed, and, it is believed, answered, in a 12-page booklet, copies of which can be had upon application to Warren, Webster & Company, Camden, N. J.

Northern motors, for operating blowers and fans, are the subject of an illustrated folder issued by the Northern Electrical Manufacturing Company, Madison, Wis. The folder states that electrically-driven blowers and fans can be operated where most convenient, regardless of distance from the prime mover; can be operated for an hour or a day economically, and when not running cause no drain on the power system by transmission losses. Electrically-driven blowers and fans can be started and stopped from any distance, and require only occasional inspection and oiling. The folder states also, that Northern motors are operating blowing and ventilating devices in a great number of American industries, where they have given uniform satisfaction.

Steam-steering engines, tiller-steering gears, electric-steering gears, telemotors, hoisting engines, evaporators, distillers, etc., are illustrated and described in a very complete catalogue of 116 pages issued by Williamson Brothers Company, Philadelphia, Pa. The catalogue states that many new devices and machines have been adopted in the company's business, and that the Williamson engines have been extensively used all over the world for many years. The company's hoisting and steering engines are especially well known, and the demand for them has been so great, so it is said, that the firm has been obliged to erect several large new buildings. In the back of the catalogue is much useful information, such as rules governing the inspection of boilers, rules for the care and management of boilers, rules to find the horse power of an engine, the weights of various substances, tensile strength, the capacity of cisterns in gallons, tables of pitch, breaking, proof and working strains. This catalogue, which is one that every engineer, steamship builder, or owner should send for, may be had by readers of Marine Engineering for the asking.

IN THE BUSINESS CENTER.

It Will Pay You to be Represented

. . . The Exhibition Department of the BOURSE presents an opportunity to Marine Engine and Boat Builders to maintain a permanent exhibit in the business center of the city, where they will come in contact with Buyers from all over the country. Address . . .

THE BOURSE, Phila.

BUSINESS NOTES.

The Philip Carey Manufacturing Company, Lockland, Ohio, manufacturer of asbestos and magnesia pipe and boiler coverings, has an exhibition at the World's Fair, St. Louis, where magnesia and asbestos is shown in all forms, from the crude product to the manufactured article.

New agents appointed.—The France Packing Company, Tacony, Philadelphia, Pa., has appointed as agents, J. G. Iler, Greenville, S. C.; Garbott & Schneider, Minneapolis, Minn.; Rockwell & Fowler, Nashville, Tenn.; A. D. Lasher, Utica, N. Y.; Philip Meyer, Fostoria, Ohio; and R. Gardner, Westerly, R. I.

The Auburn Ball Bearing Company has removed from Auburn to 18 Commercial street, Rochester, N. Y. This company makes ball thrust bearings, ball thrust washers, ball aligning step and pedestal bearings, ball thrust propeller bearings, compound ball thrust and journal bearings, ball journal bearings, ball bearing hubs, power transmission specialties, steel balls, crucible steel disks, and ball bearings suitable for engineering purposes.

Sirocco ventilating fans.—In a paper read before the Manchester Geological and Mining Society upon "The Mechanical Equipment of Collieries," Mr. George H. Winstanley stated: "The Sirocco fan has not hitherto figured prominently as a colliery ventilator, the explanation being that its makers were fully occupied in meeting the demands made by the Admiralty and others who had recognized its immense advantage. The most interesting feature about this fan is that it 'knocks on the head' many of the generally-accepted theories with regard to centrifugal fans. For instance, it has been held that the velocity with which the air leaves the tip of the blades is, theoretically, the same as the circumferential velocity of the fan itself, and in actual practice somewhat less. Actual measurement in the case of the Sirocco fan proves beyond the possibility of doubt that the air leaves the periphery with a velocity almost twice as great as the velocity of the fan itself. This means that a small fan of this type will deal with a much greater volume of air than a larger fan of any other make, whilst the useful effect is somewhat higher. In the Sirocco fan, remarkable as it may appear, the actual water gauge is greatly in excess of the so-called theoretical or calculated water gauge, and to produce a given water gauge this fan has, I believe, a lower circumferential velocity than any other type of fan in existence. The distinctive features of the Sirocco fan are these: it has an absolutely clear inlet of practically the same diameter as the fan itself. (Other fans have the inlet much smaller in diameter than that of the revolving portion). The blades are very short radially, being only about 1-16 of the fan diameter. The width of the blades, however, is greater than usual, about 3-5 of the diameter. There are a larger number of blades than are usually found in centrifugal fans, 64 being the number adopted in the Sirocco. The blades take more the form of scoops, with a forward curvature, and in working there is an entire absence of eddy current. The casting is of the usual form, spiral, with an expanding chimney. Altogether, this fan attains such astonishing results as to merit the most careful attention of all those who are interested in fan construction and mechanical ventilation. As an example of what the Sirocco fan can do in actual operation, and in comparison with other mechanical ventilators for colliery purposes, a fan of well-known make at a Lancashire colliery is producing 233,000 cubic feet per minute. This fan is 24 feet in diameter, and the circumferential velocity 7,425 feet per minute. A Sirocco fan has recently been installed in a colliery in the north of England; it is 75 inches in diameter, and is producing 226,000 cubic feet per minute, circumferential velocity 5,770 feet per minute." Sirocco fans are manufactured by the Sirocco Engineering Company, Belfast, Ireland, and 22 Thames street, New York.

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the only white pigment that will withstand the conditions of marine service.

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"BENEDICT = NICKEL"

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CORROSION is impossible, as the tubing is so perfectly homogeneous.

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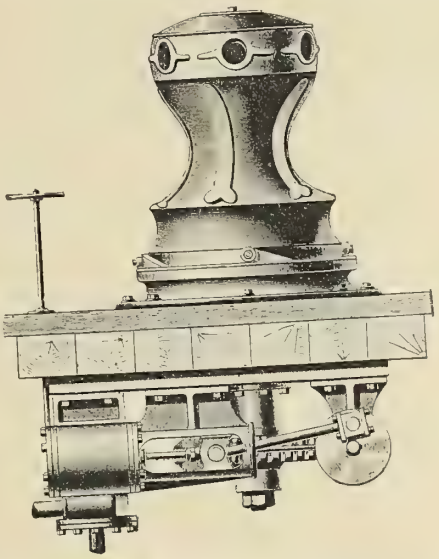
With extra heavy warping barrel; one of the many **Capstans, Windlasses, Steering Engines,** and **Other Yacht and Ship Fittings** which we manufacture.



For Particulars Address

THE TEXTILE-FINISHING MACHINERY CO.

17 EXCHANGE PLACE, PROVIDENCE, R. I.

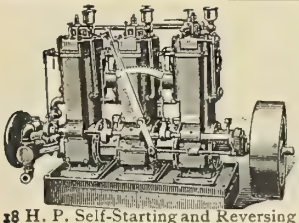
NEW YORK OFFICE, 39 CORTLANDT STREET

Steel castings.—The Delaware River Steel Casting Company, manufacturer of open-hearth steel castings, office and works, Chester, Pa., is distributing a letter which states: "We take this opportunity of informing our friends and the users of acid open-hearth steel castings in general, that we are now prepared to receive and execute orders for steel castings promptly and in accordance with specifications, where same are required. Our main foundry is 127 feet wide by 500 feet long, and contains 64,000 square feet of working surface. It is equipped with one 30-ton and two 20-ton electrical cranes with auxiliary hoists, also smaller electric cranes, and all modern machinery and tools necessary to get out our product with dispatch. Each department of our plant has at its head one thoroughly experienced in his line of business, therefore insuring those who may favor us with their order castings they can depend on being first quality and of the highest order of foundry finish."

Railway dry-docks and marine railways.—The H. I. Crandall & Son Company, East Boston, Mass., has secured the contract for a railway dry-dock of 4,500 tons' capacity for the Southern Pacific Company, San Francisco, Cal.; for a steel marine railway for the Tabasco-Chiapas Trading and Transportation Company, Frontera, Tabasco, Mexico. The Crandall Company is also supplying a Crandall patent release bilge block on the Piraeus, Greece, railway dry-dock, and is building a large dry-dock for the Victoria Machinery Depot Company, Victoria, B. C.

The American Bureau of Shipping, 66 Beaver street, New York city, in the *Record of American and Foreign Shipping*, reports the following vessels classed and rated: American screw *Acapulco*; American screw *General Joseph E. Johnson*; American screw *George W. Clyde*; American screw *City of Benton Harbor*; American screw *Indianapolis*; American screw *Corona*; American screw *Advance*; American screw *Manchuria*; American barkentine *Auburndale*; American barkentine *Glad Tidings*; American bark *Adolph Obrig*; American schooner *William E. Bowen, Jr.*; American screw *Merrimack*; American three-masted schooners *Margaret M. Ford, D. Gifford*; American schooner *Jacob S. Winslow*; British three-masted schooner *Rothesay*; British three-masted schooner *Phœnix*; British three-masted schooner *Ivanhoe*; British three-masted schooner *Helen E. Kenny*; British schooners *Eoniform, Vinita*; British bark *Robert S. Bosnard*; Swedish bark *Tordenskjold*; and Swedish three-masted schooner *Dristig*.

Twentieth century gasoline motors.—The Racine Boat Manufacturing Company, Muskegon, Mich., reports several new features in its 1904 model of gasoline engines. Among them are a float feed carbureter, which the company claims entirely eliminates the liability of flooding, jump-spark ignition, rotary water pump, self-oilers, and under-water exhaust. It is stated that this method of exhaust entirely does away with the smell of gasoline, and with the usual noise of an exhaust, without producing back pressure. The overflow water is carried into the exhaust pipe, which cools it before entering the exhaust pot or muffler. The force is reduced here before entering the water through the bottom of the boat. The outlet is so arranged as to form a vacuum when the boat is running, and in this way it is said that the feeding of the engine of the exploded gases is made easier, rather than being hindered. The lever control is the same as is used on all high-grade automobiles, but also includes the shifting of the propeller blades, in addition to the control of the spark and gases. This device, the company states, gives an even speed whether working against load or light—the motor producing the same number of revolutions without the use of complicated machinery, and the speed of the boat is controlled entirely by changing the pitch of the wheel. The Racine Boat Manufacturing Company also builds steel and wooden boats of all sizes and styles, from a small row boat to a 300-foot steel steam yacht.



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"WOLVERINE"

Self-Starting and Reversing, **GASOLINE MARINE ENGINES** Safe, Compact, Powerful, Economical.

The LEVER { STARTS IT. REVERSES IT.

Absolutely Reliable. No "Cranking." No Vibration.

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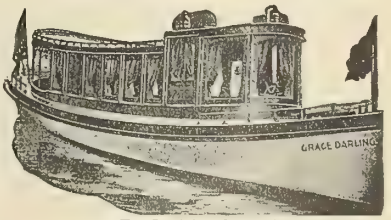
WOLVERINE MOTOR WORKS, Grand Rapids, Mich., U. S. A.

New York Office, 49 Warren Street.



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Manufacturers of OPEN HEARTH STEEL CASTINGS

From 10 to 50,000 Pounds Weight.

WILL BUILD FIVE FERRYBOATS.—The Maryland Steel Company, Sparrow's Point, Maryland, has secured the contract to build five steel double-end screw ferry boats to be built by the city of New York for the Staten Island ferry.

FREDERICK S. NOCK, naval architect and builder, East Greenwich, R. I., reports that he is building a boat for the Buffalo Gasoline Motor Company, Buffalo, N. Y., 45 fet over all, to be equipped with a Buffalo motor; the boat to be used for demonstration purposes. Mr. Nock says the *Turtle*, a hunting cabin launch designed and built by him for Mr. F. W. Albree, Kingston, Ontario, recently left his yard and made a trip to Canada via Lake Champlain. Considering the time consumed traveling through the canals she made a fast trip. Mr. Nock recently launched the yawl *Procyon*, owned by Mr. C. A. Goodwin, Hartford, Conn. He has also just finished a 28-foot speed launch for Mr. L. O. Meacham, which will be kept at West Brook, Conn.

ILLUMINATED DIAL GAUGES.—The Standard Gauge Manufacturing Company, Syracuse, N. Y., with branch offices at 141 Broadway, New York city, and 58 West Washington street, Chicago, Ill., reports that the Standard Illuminated Dial Gauge is meeting with general favor with many of the leading shipbuilding companies and ships' engineers. This gauge is particular well adapted for locations where it is necesasry to place the gauge at an elevation, or in rooms where the light is not sufficient to show the pointer distinctly on ordinary gauges. These gauges are made with other single or double Bourdon tubes, also with single Bourdon tube with auxiliary spring. Circulars and full information regarding the gauges can be had by corresponding.

PARSONS' WHITE BRASS.—The William Cramp & Sons Ship and Engine Building Company, Philadelphia, Pa., reports that the Parsons white brass, which it manufactures for piston-valve rings, crank pins, stern bushing, etc., is filling a want among engineers, shipbuilders, and owners. Following are extracts from testimonials the company has received: (From the Clyde Steamship Company, New York): "We have had many kinds of meal presented to us, and have tried many, but have never found any equal to the Parsons white brass. We have engines making a piston speed of 800 feet per minute fitted with Parsons' white metal in the main bearings, crank pins, and other journals, and in constant use for fifteen years and never removed." (From the Oceanic Steamship Company, New York): "The chief engineer of the *Mariposa* reports that a year ago last April, at Sydney, the entire crank shaft was raised up 14 inches to examine and line up the boxes, and the white metal was found to be in good condition, not having worn down more than one-sixteenth of an inch in nine years. All of the journals working on No. 32 impression A. W. G. are in fine order." (From the Baltimore and Philadelphia Steamboat Company, Philadelphia): "Your letter of the 11th received and contents noted. I have Parsons' white brass installed on the following ships and steamboats: *Manahatta, Chesapeake, Bluefields, City of Philadelphia, Ericsson, A Groves, Jr.* Originally these vessels were supplied with other metals which caused considerable trouble. Since installing Parsons' white brass I have no more complaints from our engineers. This metal is now in use three years and I recommend its further use. Signed, George F. Drury, Supt. Engineer."

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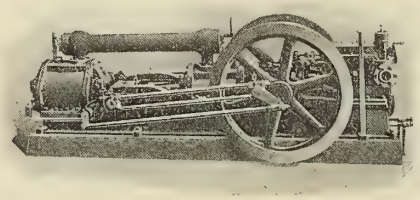
THE INDUSTRIAL RAILWAYS, hoisting engines, conveyors, and other machinery manufactured by the C. W. Hunt Company, West New Brighton, Staten Island, N. Y., are on exhibition at the World's Fair, St. Louis, in the Court of the Palace of Electricity.

MORE SPACIOUS STORES.—Owing to the vast increase in its business, the New York Belting and Packing Company, Ltd., has removed to much larger and more spacious stores, No. 91-93 Chambers street, New York city, and extending through, making entrances also at 73-75 Reade street. This location is only a few doors west of Broadway. The company invites all of its friends and others who are interested in high-grade mechanical rubber goods to call. In connection with the show rooms there has been fitted up a very complete room provided with all the necessary facilities for correspondence, telephone, etc. This new store is believed to be the finest rubber store in the country.



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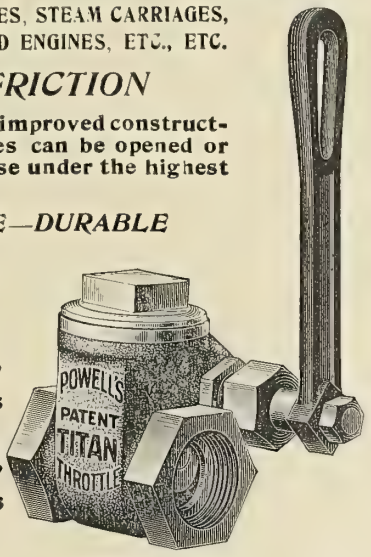

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An Appendix contains chapters VII. and VIII.

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The Rand Drill Company, 128 Broadway, New York city, has secured the contract for furnishing two compressors to be used in the Central Air Power plant near Sault Ste. Marie, Mich. These compressors will supply air to operate 25 "Little Giant" rock drills, 4 three-ton cable ways, and 4 water pumps. Their combined capacity is 6,600 cubic feet of free air per minute. The work in hand is the construction and dredging of a two-mile channel in the Soo river, of sufficient size for the passage of large vessels.

Lunkenheimer exhibit at St. Louis.—In Machinery Hall building, location 5 G, Block 26, is the unique exhibit of the Lunkenheimer Company, Cincinnati, Ohio. It is easily identified by a large model of the familiar "valve in hand," which occupies a prominent corner of the exhibit. Pyramids of globe, angle, cross, lever, and gate valves, of various designs and sizes, both brass and iron, are artistically arranged about the exhibit, and are agreeably off-set by a black plush curtain at the side and rear. The glass cases arranged in front of the exhibit contain a smaller class of Lunkenheimer goods, such as lubricators, oil and grease cups, cocks, etc., of all sizes. Neat designs of racks containing various sizes of whistles, injectors, pop valves, and a variety of other specialties, lend to make up an exhibit worthy of notice. A new design of water gauge, and oil pump for cylinder lubrication, are features in themselves. Dispersed about the exhibit are pipe fittings of every description, together with whistles, safety and check valves, and numerous other appliances. The large variety of steam goods exhibited by the Lunkenheimer Company, necessitates more than a casual glance to thoroughly appreciate the exhibit in all its details.

Standard Roller Bearing Company.—The capital stock of the Standard Roller Bearing Company, Philadelphia, Pa., has been increased from $1,000,000 to $2,000,000. There will be immediately erected a 250-foot addition to the machine shop and factory, as well as an office building two stories in height. This addition will be devoted exclusively to the manufacture of roller bearings, etc., while an addition, 50 feet by 125 feet, three stories in height, will be made to the ball plant, and be in full operation within sixty days. About $250,000 will be expended in the construction of the two buildings and in equipping them with machinery. It is expected that all of the building operations will have been finished by the first of October. Two years ago the Standard Roller Bearing Company purchased about three acres of ground about fifteen minutes' ride from the center of Philadelphia. Upon this property was erected a modern up-to-date machine shop, with power house, forging, and hardening departments in separate buildings. Possession was taken of this property January 1, 1903, since which time the company has built and installed its own brass and iron foundries, and at the present time does not purchase anything whatever in the open market except the raw iron, copper, etc., for its foundries, and steel from which to make bearings.

Back Numbers Wanted

We will pay twenty cents apiece for good copies of *Marine Engineering.*

for either

JANUARY,
FEBRUARY,
MARCH,
APRIL,

1904

MARINE ENGINEERING, 309 Broadway, New York

Thermometers in the Navy.—The Bureau of Steam Engineering of the Navy Department, Washington, D. C., has directed that in all cases where thermometers are not already ordered and delivered, that approved mercurial thermometers be fitted instead of dial thermometers, on all vessels building. This rule is not intended to apply to special high-grade pyrometers, when required for specific purposes.

Blue printing frames.—The Keuffel & Esser Company, 127 Fulton street, New York city, is distributing folders illustrating and describing both the horizontal and the vertical electrical printing frames which this company recently put on the market. Frames of this nature have proved of such value in drafting rooms that any of our readers who have to do with drafting will probably want to send for a copy of these circulars so as to secure further information.

"Mobilene" sheet packing.—The H. W. Johns-Manville Company, 100 William street, New York city, recently received a letter from Mr. Alfred Franklin, owner of the launch *Polaris,* as follows: "I have used your 'Mobilene' sheet packing this whole season on the cylinder head of a six-horse-power gasoline engine in my launch, the *Polaris,* and have found it to be the best and most satisfactory cylinder-head packing on the market. Previously I always had trouble with other makes of cylinder packing, but since I applied 'Mobilene' I have not once been bothered." Any reader of Marine Engineering interested in the subject of packing for gasoline engines should send to the H. W. Johns-Manville Company for a copy of the pamphlet entitled "How to Pack a Gas Engine."

Lining for refrigeration.—A new lining ("Arctic" brand of Keystone Hair Insulator), especially for refrigerator insulation, has been placed on the market. Its distinctive characteristic is, that while it possesses the insulating properties of hair felt, it combines the papers used in connection therewith, so that instead of involving three operations, the "Arctic" can be applied in one. It consists of regular felting hair fastened to and enclosed by two layers of waterproof paper. "Arctic" is furnished according to specifications, to fit nailing strips. It is made from 3-8 to 3-4 inch thick, according to the quantity of hair employed. The H. W. Johns-Manville Company, the manufacturer, 100 William street, New York, is prepared to figure upon specifications and furnish samples, data of tests, etc., promptly upon request.

Westinghouse Exhibits.—The several Westinghouse companies make extensive exhibits at the St. Louis exposition. Most notable of them all is the main service plant, which consists of four big electric generating units, each of 2,000 Kw. capacity. This exhibit is located in the central aisle of Machinery Hall. These generators are three-phase alternating current, operating at a speed of 83 1-2 revolutions per minute, and furnished by the Westinghouse Electric and Manufacturing Company, delivering current at 6,600 volts. The engines are Westinghouse-Corliss, vertical cross compounds, furnished by the Westinghouse Machine Company. The boiler plant was supplied by the Westinghouse Machine Company, and consists of Babcock & Wilcox boilers. The various Westinghouse companies are represented in all parts of the exposition grounds, and in order to make it possible for the visitor to select those special exhibits which he most wishes to see, a guide is published which can be had at any of the Westinghouse exhibits, or by communicating direct with the publishing department of the Westinghouse companies, Pittsburg, Pa. Among the many exhibits of these companies, of interest to our readers, in addition to those already mentioned, are the Westinghouse Air Brake Company, the Perkins Electric Switch Manufacturing Company, the Bryant Electric Company, the SawyerMann Electric Company, the Nernst Lamp Company, and the Cooper-Hewitt Company.

MARINE ENGINEERING
EMPLOYMENT BUREAU.

Full information regarding the purposes of this bureau, together with instructions regarding registration, etc., furnished upon application to Marine Engineering Employment Bureau, 309 Broadway, New York City.

All correspondence, concerning either vacancies or situations wanted, is strictly confidential.

POSITIONS SEEKING MEN.

BOILER-SHOP FOREMAN. Must be familiar with various types of marine boilers and capable of handling repair work. Knowledge of shipbuilding and repairs will be of great advantage. File 10.

CHIPPERS AND DRILLERS can find a position in a large shipyard if experienced. File 30.

FOREMAN FOR BOAT BUILDING SHOP who has had experience in constructing new hulls, who can attend to repair work and is familiar with gas engines. File 15.

FORGINGS SALESMAN wanted who is acquainted with the manufacture and use of high-grade forgings, has had experience as a salesman and who has acquaintance in this special direction. File 25.

SALESMAN FOR STEEL CASTINGS, both large and small, is wanted who understands steel casting business and who has acquaintance among purchasers. File 26.

SKILLED BOAT BUILDER who has had experience in handling men, and who can attend to the hull work in large launch works. File 14.

SUPERINTENDENT, DESIGNER AND FOREMAN wanted in a shop devoted to the building of small pleasure boats File No. 35.

MEN SEEKING POSITIONS.

We have applications registered for positions as follows, and the references of each applicant have been carefully investigated:

ASSISTANT SUPERINTENDENT, ENGINEER OR ASSISTANT ENGINEER IN ENGINEERING WORKS. Age 28; single; of English birth; has British and American licenses and has had several years' sea experience. Application No. 23.

BOILER-SHOP FOREMAN. Age 35; single; many years' experience in Navy Yard and leading shipyards. Application No. 59.

CHIEF OR ASSISTANT DRAFTSMAN—ENGINE. Age 32; married; has had sea experience and several years' experence in government and private shipyards. Application No. 25.

CONSULTING ENGINEER AND NAVAL ARCHITECT. Married; born in Germany; had many years' experience in designing, drafting and surveying. Application No. 33.

DRAFTSMAN, ENGINE AND BOILER. Age 30; unmarried; has Danish marine license; technical school graduate. Application No. 57.

DRAFTSMAN—HULL. Age 20; single; experienced in architectural work, but prefers marine drafting. Application No. 51.

DRAFTSMAN—HULL. Age 25; married; 9 years' experience in leading yards in drafting, testing materials, surveying, etc. Application No. 54.

DRAFTSMAN—HULL, OR INSPECTOR. Age 37; married; had experience both in government yards and private yards. Application No. 30.

DRAFTSMAN—HULL. Age 22; single; born in Norway; studied Technical schools in Norway and Germany; experience as draftsman, also as shipfitter. Application No. 31.

DRAFTSMAN—HULL. Age 25; single; born and educated in Germany; has had 7 years' experience in drafting, sea duty as engineer, and as shipfitter. Application No. 52.

DRAFTSMAN—HULL AND ENGINE. Age 26; single; graduated Webb Academy; has had four years' experience in navy yard work; desires connection with private shipyard. Application No. 41.

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TRADE PUBLICATIONS.

Flexible staybolts are illustrated and described in a pamphlet issued by the Flannery Bolt Company, Pittsburg, Pa. This bolt was described in the August issue of Marine Engineering.

Staybolt iron.—The Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, is sending out mailing cards on which it makes the following claims regarding its hollow staybolt iron: that it is the only staybolt iron which responds in service to the expansion and contraction of the fire box, which relieves the material in molecular strains, which is self-protected from burning, which does not make the side sheets crack, which earns its own cost in oxygen through it to the fire, which is always sure in giving warning of breakage.

Smooth-on cement packing, a new article made of a combination of smooth-on iron cement and rubber, is placed on the market by the Smooth-on Manufacturing Company, Jersey City, N. J. A pamphlet issued by the company states that the smooth-on in the packing has the same action as when in the powdered cement form—that of expanding slightly when it comes in contact with water or steam—thus rendering it useful for making flanged joints. It metalizes and thereby strengthens the packing and makes a lasting joint, which will not blow out, and which will withstand very high pressures and temperatures.

The Fire Engineers' Hand Book, containing valuable information regarding hydraulics, first aid to the injured, and "fire-hose talk," is issued by the Fabric Fire Hose Company, Sandy Hook, Conn. This company's specialty is the manufacture of a new kind of fire hose which is claimed to be absolutely waterproof. The waterproofing is accomplished by running each thread of cotton through a mixture of melted wax and gum. The fibres are then collected into strands, twisted and cabled, and become a collection of waxed ends, much the same as is done by a shoemaker or harness maker. These cables are then circularly woven into the fabric in one, two, three, and four independent plies, or double and triple jackets, and lined with Para gum. Extracts appear in the book from several hundred testimonial letters received by the company.

Engineering specialties.—James L. Robertson & Son, 204 Fulton street, New York city, have issued a 64-page illustrated catalogue, and every engineer should send for a copy, as it contains a great deal of information which will be a great aid when ordering supplies. Regarding its indicator the catalogue says: "The Robertson-Thompson indicator is a modern instrument, and was designed for the attainment of the greatest accuracy when used in connection with the high speeds in use in modern engineering practice. It is wide, with perfectly adjusted bearings, the moving parts are light, and the construction simple." Regarding the company's "take-up" device, the catalogue says: "Knowing the great trouble experienced in using detent motions on indicators to keep the cord from slipping off the drum, getting tangled and breaking, we have devised a take-up device which is so arranged that it can be put on indicators and take the place of a regular cord pulley. It can be used on reducing motions or any other attachment between the crosshead and drum of the indicator. The object of the device is to immediately pick up all slack cord which is found when detent motion is used on an indicator. The device is very simple, cannot get out of order, and requires no attention." Among the other specialties described in this catalogue are steam damper regulators, Hine eliminators, Reliance safety water columns, copper coil feed-water heaters, hot-water generators, regulating and reducing valves, pump governors, pressure regulators, steam separators, and grease extractors, automatic injectors, oil filters, exhaust pipe heads, grate bars, grease cups, "Eureka" packings, packing tools, recording gauges, gauge testing outfits, double-acting power pumps, planimeters, thermometers, oil pumps, and water gauges.

Induction coils.—The Induction Coil Company, Milwaukee, Wis., is mailing a catalogue describing and illustrating its induction coils. These coils are made for either dynamo or battery, as desired. The windings are made of silk-covered wire insulated by a special process. The core is made of annealed soft iron wire. The insulation between the primary and secondary wires is of the heaviest material possible consistent with correct construction. The insulating is especially designed to exclude all dampness. The vibrators are proof against "sticking," as the points of contact are made of platinum iridium. All styles of coils are made, for launches, stationery engines, and for automobiles. Every coil is tested before being placed on the market.

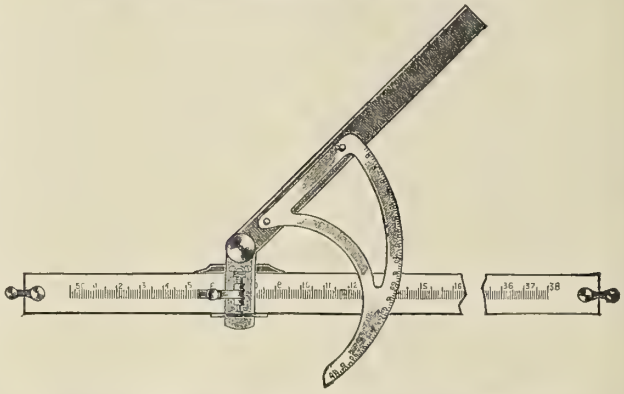
Gasoline marine engines are illustrated and described in a 64-page catalogue sent out by the Standard Motor Construction Company, 172 Whiton street, Jersey City, N. J. The Standard motors are of the four-cycle type. Among the advantages claimed for these motors are: the time of ignition may be varied in all cylinders with but one lever; the speed may be instantly changed without altering the mixture ;the automatic vaporizer does not require adjusting for any variation of speed, nor any regulation of the air supply; varying speed may be attained by means of the automatic governor; supply valves have air cushions; reverse gears run in oil-tight gear cases; the starting and reverse lever is easily operated; all parts are subjected to positive lubrication; the engine is smooth running and free from vibration; the exhaust is noiseless and free from excessive heat; one man can handle the boat from the pilot house; positiveness in starting and operating the engine; large margin in power above the amount rated. This company made the auto boat *Standard,* winner of many races in New York harbor and vicinity.

River navigation is the title of a pamphlet published by the Marine Iron Works, Station A, Chicago, Ill. This pamphlet says that the elements which enter into the design and construction of steam craft are more than usually numerous and conflicting when the boat is to be used for business purposes on shallow rapid rivers. The machinery, equipment and power must be proportioned not only to the hull, the load which the boat is to handle, and the runs it must make, but also to the shallow water and swift currents. All this requires a careful distribution of the weights and stresses, while the character of the feed water for the boiler, and the kind of fuel burned demand considerable attention. In fact, all the local conditions of each case should be well understood. The importance, also, of having a substantial hull, together with the necessity for very light draft and yet liberal carrying capacity, requires minute calculations of the weight and strength of material for the hull, as also the model or bearing lines that are to sustain the boat. The Marine Iron Works make a specialty of light-draft boats for river navigation, and any one desiring such a boat would do well to send for a copy of this catalogue.

IF A

Starrett Protractor

is once used, to use any other will be like returning to a bad habit.



In Material, Design, Workmanship, and Accuracy, this instrument is not excelled.
Made with bevel arm 15 to 36 inches; auxiliary blades carried in stock up to 36 inches.

Send for our FREE CATALOGUE No. 17L, which tells of all the STARRETT TOOLS.

The L. S. STARRETT CO., ATHOL, MASS.

A Chance Courtship

is a story of an unconventional love match, well told and beautifully illustrated. As a bit of readable fiction the story is well worth writing for. It is contained in a handsomely bound book of 128 pages, a portion of which is devoted to the attractive mountain and lake resorts along the Lackawanna Railroad. It is a book you will like to see. It may be had by sending 10 cents in postage stamps to T. W. Lee, General Passenger Agent, Lackawanna Railroad, New York.

NEW CATALOGUE FRESH FROM THE PRESS—ASK FOR IT.

THIS SPACE is too limited to give any idea of our splendid line of

Marine Engineering Thermometers and Gauges

Our New Catalogue No. 1 tells all and it's well worth asking for.

HOHMANN & MAURER MFG. CO., ROCHESTER, N. Y., U. S. A.

NEW YORK
85 CHAMBERS STREET

LONDON, ENG.
98 CLERKENWELL RD., E. C.

CHICAGO
119 LAKE STREET

The tendency of to-day

is to use grease wherever possible, because of its reliability and economy.

Dixon's new Booklet

Oil vs Grease

carefully discusses the question with particular reference to

Dixon's Ticonderoga Graphite Greases

Write for a free copy.

JOSEPH DIXON CRUCIBLE CO.

Jersey City, N. J.

Please Mention This Publication.

Last Chance at

Bound Volumes

OF MARINE ENGINEERING

Only a few Stray Volumes Remain as follows:

1899, Vols. III. and IV., Price	$2.50
1901, Vol. VI. . . . "	4.00
1902, Vol. VII. . . . "	4.00
1903, Vol. VIII. . . . "	4.00
	$14.50

$10.00 gets the Set of Four Books

Each volume is substantially bound in black cloth with leather corners and back.

YOU PAY EXPRESSAGE

Marine Engineering, 17 Battery Place, New York

The De Laval Steam Turbine Company, Trenton, N. J., is mailing a folder calling attention to the advantages of its turbine for direct-connected purposes. Among the advantages claimed are compactness, saving of foundations, simplicity, and economy of operation. Catalogues sent upon application.

The preservation of metal surfaces is the principal topic of discussion in the September issue of *Graphite*, published by the Joseph Dixon Crucible Company, Jersey City, N. J. An article by Mr. R. H. Fisher states that "in selecting a paint for the preservation of steel, the first consideration must be the purity of the ingredients. The vehicle must be only the purest of fire-boiled linseed oil, for eventually the life of the paint will depend upon the oil. The pigment must be one that will not undergo chemical change under any condition, and it must assume such form that it may be made to protect the oil or binder, and at the same time readily shed water. Also, it should work easily under the brush, thus insuring a good covering capacity. On enclosed work the paint is subjected to alkali, and in nearly all buildings the basement and first two stories are subjected to the action of such powerful corrosives as the sulphurous fumes produced by the process of combustion." The Joseph Dixon Crucible Company claims that its silica-graphite paint meets all the above requirements. This paint is being used by the North German Lloyd Steamship Company on its new piers at Hoboken, N. J.; on the new Trinity building; and on the new St. Regis Hotel, New York city, and on many other well-known buildings throughout the country.

A new clamp ring.—The Brown & Sharpe Manufacturing Company, Providence, R. I., is mailing a folder calling attention to a new clamp ring for micrometer calipers, which it has placed on the market. The folder says: "The device is simple and unusually efficient, a slight movement of the knurled ring being required to clamp the measuring spindle securely. It does not rotate the spindle when clamping. It is often desirable, after a measurement has been taken, to clamp the spindle to retain the setting, and it is important that the spindle should not be rotated or moved longitudinally. The construction of the device is such that the possibility of disturbing the adjustment when clamping is entirely avoided. Another excellent feature is that the tension on the measuring spindle can be adjusted without disturbing the adjustment of the screw and nut. This is especially convenient when measuring a number of pieces for comparison, as sufficient tension can be put on the spindle to prevent its turning when the work is passed between the measuring points, and at the same time the spindle can be left sufficiently free to allow of slight adjustments. The rotation of the spindle cannot alter the setting of the tension. The various parts are accurately fitted together to prevent the possibility of any dirt getting into them, and the movement of the parts is so slight that there is practically no wear."

WATCH THIS SPACE FOR OUR NUMEROUS SPECIALTIES.

WALWORTH MFG CO. TOOLS and SUPPLIES for STEAM WATER and GAS USERS BOSTON MASS.

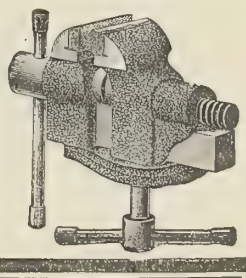
Walworth Extra Heavy Bench Pipe Vise

Is made especially for use in

MARINE REPAIR SHOPS AFLOAT AND ASHORE,

Grips pipe 1 to 6 inches inclusive, and by reason of its solid and substantial "make up," also furnishes a first-class tool for general machine work.

Will not Crush or Jam Pipe Like Ordinary Vises



JOBBERS SELL THEM—IF YOURS DON'T, WRITE.

New York, Park Row Building. **WALWORTH MFG. CO.,** Boston, 128 Federal Street.

Write for our BLUE CATALOGUE "D." showing complete line of engineers' pipe fitting tools.

Self-locking screw clamps are described and illustrated in Catalogue No. 5, issued by James L. Taylor, 30 Lawrence street, Newark, N. J. These clamps should have a good sale among shipyards and boat shops. They are designed, so the catalogue states, to fill a long-felt want for an efficient and time-saving clamp, and have been severely tested with satisfactory results in the Brooklyn and Charleston navy yards.

Pneumatic compression-yoke riveters, portable and stationary, for boiler makers, shipbuilders, etc., are the subject of illustrated Catalogue No. 3, issued by the Hanna Engineering Works, 820 Elston avenue, Chicago, Ill. Regarding these riveters the catalogue states that in them is combined in a simple form toggles, levers, and guide links, to give the large opening of the toggle joint movement with its gradually increasing pressure until the desired pressure is reached, then a simple lever movement throughout a considerable space under uniform maximum pressure. This space, where a uniform maximum pressure is available, is sufficient so that there need be no uncertainty about the pressure applied to the rivet; and the machine being once adjusted for a certain length of rivet and thickness of plate, will require no further adjustment for ordinary variations in lengths of rivet, heat, or thickness of plates.

Northern steel spherical motors for direct connection to machines and tools are illustrated and described in Booklet 33, issued by the Northern Electrical Manufacturing Company, Madison, Wis. The booklet states: "The popularity of the Northern steel spherical motors has caused demand for these motors in the smaller sizes, and to meet this our engineers have from time to time added new small frames to such an extent that we have decided to classify them separately, to make them more easily distinguishable, and to avoid encumbering our lists of other sizes with these machines. The purpose of this booklet, therefore, is to give to these small motors a place by themselves. These machines are miniature representations of the standard spherical motors built by this company, with such deviations from our regular construction as are necessitated by the smallness of the machines. In designing these new sizes, our engineers have had uppermost in their minds machines which would merit the name 'Northern.' Coupled with the desire to produce a worthy machine has been the aim to devise details, which, by their simplicity, strength and convenient arrangement should make the motors so easy to operate and cheap to build as to extend materially the field of the small motor. The machines are all multipolar, with bar or coil wound armatures, susceptible to good speed regulation."

Marine gasoline engines are illustrated and described in a catalogue issued by the Wolverine Motor Works, Grand Rapids, Mich. This company makes gasoline, pleasure, and business boats of all descriptions. The following is a copy of a testimonial the company has recently received from the Muskegon River Transportation Company, Newaygo, Mich.: "The gasoline boat *Helen C. La Moore,* built for us by the Wolverine Motor Works, is a fine boat, and exceeds our expectations in many ways. She is running between Muskegon and Newaygo, a distance of 49 miles, up the Muskegon river, which is a shoal, swift running stream. We think your chainless stern wheel transmission is the only transmission. We are giving ours a severe test every day and do not think a sprocket wheel and chain is to be compared with the cranks and side rods, and to any one interested in river navigation we cheerfully and heartily recommend this type of boat. The engine has never given us any trouble, and is so simple any one can start it and run it. We can run it from 25 revolutions to 300 revolutions per minute, and we consider it just as reliable as steam, and could not be induced to change to steam. To any one building a boat, or contemplating building one, we do not hesitate to advise them to investigate the Wolverine motor. We expect to want several more of your motors in the near future, as they are very economical on fuel."

IN EVERY SEA

that is furrowed by prows of trade or war,

Oxide of Zinc

holds its own against the varying elements. It is the only white pigment that can withstand marine exposure.

FREE: OUR PRACTICAL PAMPHLETS

"The Paint Question,"
"Paints in Architecture,"
"Paint: How, Why and When."

THE NEW JERSEY ZINC CO.
71 BROADWAY
NEW YORK

We do not grind zinc in oil. List of zinc paint manufacturers is furnished on request.

CONDENSER TUBES

last longest if made of

"BENEDICT-NICKEL"

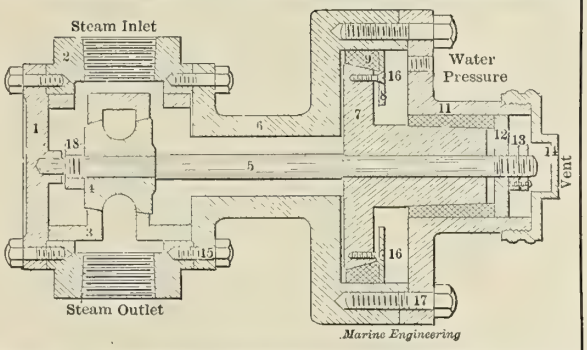
ELECTROLYSIS is positively resisted because "Benedict-Nickel" is an alloy of nickel and copper.

CORROSION is impossible, as the tubing is so perfectly homogeneous.

Our treatise on "Electrolysis of Condenser Tubes" is very valuable and costs you nothing. Send for it.

BENEDICT & BURNHAM MFG. CO.
WATERBURY, CONN.
New York, 253 Broadway Boston, 172 High St.

Reward for Your Thoughts



MULLIN'S
Automatic Controller
for
Boiler Feed Pumps

THE GREAT POINT in this valve is our ability to **always maintain** an **excess water pressure** over steam pressure, regardless of the fluctuations of the latter; without the use of springs, levers or weights.

WE WILL GIVE $100.00

$50.00 for the best,
$30.00 for the second,
$20.00 for the third

best reasoning how that excess pressure is obtained and maintained, together with conclusions reached regarding its efficiency and operation on a Battery of Boilers.

Said competition to be confined to Stationary and Marine Engineers and Firemen in the United States and Canada.

Article to contain not more than 300 words.

Competition to close November 20th, and Awards made December 1st, 1904

The writer must give his name, the name of the firm where he is employed, and the name of the Journal in which he saw this specification.

Two Competent Mechanical Engineers, assisted by our Mr. R. J. Mullin, will act as Judges.

The successful articles will be published.

The Federal Valve Co.
2534 Western Ave., Seattle, Wash.

Gas engine builders should send to the Billings & Spencer Company, Hartford, Conn., for a copy of Circular E, which is devoted to gas engine parts forged of the best steel, and which are always carried in stock for prompt delivery.

A free calendar.—The Marine Manufacturing and Supply Company, 157 South street, New York city, manufacturer of capstans, windlasses, steering apparatus, mechanical telegraphs, flags and signals, shipbuilders' materials and supplies, chandlery, hardware, and engineers' supplies, is distributing monthly a neat desk calendar, which will be forwarded upon application to readers of Marine Engineering.

Points of interest at the Louisiana Purchase Exposition, is the title of Booklet No. 41, issued by the Northern Electrical Manufacturing Company, Madison, Wis. The booklet states that the company is exhibiting modern types of machine tools arranged for electrical operation by Northern motors. Many of these machines, with their motive power, are illustrated in this bulletin. The company is also sending out a free map of the exposition grounds.

Invitation to inspect plant.—The Chapman Valve Manufacturing Company, Indian Orchard, Mass., sent engraved invitations to visit its plant to members attending the twenty-third annual convention of the New England Water Works Association, which met at Holyoke, Mass., in September. This company makes valves of all kinds, and many valves of its make are used in the United States navy and in vessels of the merchant marine.

Coal-handling machinery for boiler rooms, shipping docks, coaling stations, power stations, etc., is described and illustrated in Catalogue 047 issued by the C. W. Hunt Company, West New Brighton, Staten Island, N. Y. Automatic railways, overhead trolleys, hoisting elevators, boom towers, and steam and electric hoisting engines are among the machinery described. The catalogue states that the company has had more than thirty years' experience in this business, and that its works are completely equipped with specially-constructed machine tools.

Electrical substitute for hot-water bag.—The H. W. Johns-Manville Company, 100 William street, New York city, is sending out a mailing card on the return half of which is printed: "Kindly have your representative call with an 'Electrotherm' (the electrical substitute for the hot-water bag), to demonstrate its superiority and convenience; its constant and uniform heat subject to regulation, and its adaptability to special uses. Demonstration to consist merely in screwing the plug of the 'Electrotherm' into an ordinary incandescent light socket, and requiring not mare than ten minutes."

Mechanical accountants are described and illustrated in a booklet issued by the Mechanical Accountant Company, 17 Warren street, Providence, R. I. This company makes a machine, so the catalogue says, which will rapidly and accurately perform the most complicated kinds of arithmetical work by simply pressing the keys, without any mental calculation whatever. The machine is claimed to be constructed on entirely original lines. It is enclosed in a metal case 13 inches long, 7 3-4 inches wide, and from 2 to 6 inches high, and weighs about 12 pounds. It has a capacity of nine hundred and ninety-nine millions, which may be increased if desired. Such a problem as the following may be done by an experienced operator in 11 seconds, so the catalogue states: find the interest on $352.45 for 78 days at 4 per cent. Answer, $3.05.

ELECTRIC HEATING APPARATUS

"Unit" Enameled RHEOSTATS

Simplex Electric Heating Co.

Cambridgeport, Mass. *Send for Catalog*

Injectors, boiler testers, and steam-jet syphon pumps, are illustrated and described in a catalogue issued by the Schutte & Koerting Company, Philadelphia, Pa.

A new boring tool is described in a folder which the Goodell Manufacturing Company, Greenfield, Mass., is mailing. The tool is designed especially for boring holes where difficulty is usually experienced in using an ordinary bit brace.

Pumping machinery at St. Louis.—Forty types of pumping machinery exhibited at the World's fair, are described and illustrated in a pamphlet distributed by the International Steam Pump Company, 114 Liberty street, New York city.

Gasoline engine tests.—Fairbanks, Morse & Company, Chicago, Ill., are distributing a folder giving extracts from the record of the capacity, economy, and endurance tests of one of their 60-horse-power gasoline engines direct connected to two 10 by 12 double acting triplex pumps for the Philadelphia water works.

Clocks for engine rooms, engine counters, gauge cocks, twenty varieties of gauges, gauge boards. indicators, pyrometers, pumps of several varieties, revolution counters, syphons, and valves, are brought to the attention of engineers in a folder mailed by the Standard Gauge Manufacturing Company, Syracuse, N. Y.

Industrial applications of the Sprague electric motors are illustrated and described in Bulletin No. 218, issued by the Sprague Electric Company, 527 West 34th street, New York city. Bench drills, radial drills, centrifugal pumps, hydraulic wheel presses, pipe cutting and threading machines, are among the examples given of machine tools operated by this company's electric motors.

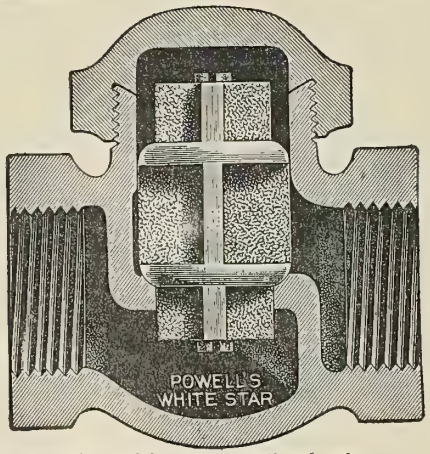
Cold saw cutting-off machines are described in a 28-page catalogue issued by the Newton Machine Tool Works, Philadelphia, Pa. Among the machines illustrated are bar cold saws, I-beam cold saws, combination cold saws, crank-shaft cold saws, special forging, girder rail, steel foundry, vertical steel foundry, double axle, and armor-plate cold saws.

Asbestine fire-proof and weather-proof cold-water paint is described in a folder issued by the Alden Speare's Sons Company, 100 William street, New York city. Eighteen samples of this paint accompany the folder, which states that the paint "gives a whiter and handsomer finish than oil paint, and contains no oil, so will not turn yellow or change color with age."

A new water-tube boiler.—The Rust Boiler Company, Pittsburg, Pa., is distributing an illustrated catalogue describing its water-tube boilers for stationary use. This boiler was first used at the works of the Colorado Fuel and Iron Company, Pueblo, Col., and the catalogue states that it has many points of superiority over the ordinary stationary type of water-tube boilers.

A good anti-fouling paint.—The Hertzog Paint and Varnish Company, Philadelphia, Pa., has received many testimonials from users of its green anti-fouling paint. C. H. Osgood, owner of the steam yacht *Narwhal* writes: "I would say that the green anti-fouling paint bought of you last spring, and used on the bottom of my steam yacht *Narwhal,* has given better satisfaction than any paint I ever used; there was not a barnacle or bit of grass upon it. It also stood well above low-water line, when exposed to the air. I shall certainly use yours again, next season."

"WHITE STAR"
Reversible and Re-Grinding CHECK VALVE



Disks in one piece with double seating heads
Both ends made to gauge.
Economical because reversible and made of best material.
Will withstand a temperature of 2,000 degrees.
Simple and convenient—Re-grinding effected by inserting screw-driver in slot at either end of disk and rotating back and forth.

THE WM. POWELL CO.
Everything in the steam line for the boiler and engine room.
CINCINNATI, OHIO, U.S.A.
New York Agent: H. H. BEALS, 51 Cliff St.
Philadelphia Agent C. J. RAINEAR & CO., 515 Arch St.

Luger automatic carbines are illustrated and described in a folder issued by Schoverling, Daly & Gales, 302 Broadway, New York city.

Steam circulation is the subject of a mailing card sent out by Warren Webster & Company, Camden, N. J. A booklet on the subject will be sent free upon application.

Flinn steam traps are the subject of a folder sent out by Richard J. Flinn, West Roxbury, Mass. This device is fully described in the September, 1904, issue of Marine Engineering.

The Fort Wayne Electric Works, Fort Wayne, Ind., is distributing Catalogue of Parts No. 2010, devoted to alternating current, 104-volt, Form C., Wood arc lamps.

Multiphase revolving field-belted generators and other electrical appliances are described in Bulletin 1057, issued by the Fort Wayne Electric Works, Fort Wayne, Ind.

Steam accumulators are the subject of Bulletin 100, issued by Henry R. Worthington, 114 Liberty street, New York city.

Diaphragm hand-power pumps, steering gears, and marine appliances, are the subject of the latest "hang it" mailing card sent out by the Edson Manufacturing Company, 255 Atlantic street, Boston, Mass. This company makes a specialty of steering gears, and its gears are in use on some of the fastest and best-known yachts afloat.

UNITED STATES METALLIC PACKINGS
RELIABLE—SATISFACTORY—EFFICIENT
FOR PISTON RODS AND VALVE STEMS OF MAIN AND AUXILIARY ENGINES
The United States Metallic Packing Co.
427 North Thirteenth St., PHILADELPHIA. CHICAGO, 509 Great Northern Bldg.

BUSINESS NOTES.

A FREE TRIAL.—The Cool Running Graphite Metal Company, 430 East 2d street, Cincinnati, Ohio, offers, in order to introduce its cool-running graphite metal, to send a free sample to all readers of MARINE ENGINEERING who mention this magazine.

NEW PACIFIC COAST AGENCY.—The Crandall Packing Company, Palmyra, N. Y., manufacturer of packings for steam, water, air, gas, and ammonia, has appointed the Pacific Engineering Company, Seattle, Wash., its agents on the Pacific coast. The Pacific Engineering Company is composed of Mr. J. P. Badenhausen, formerly with the Hamburg-American line at Hoboken, N. J., and Mr. C. B. Lamont, formerly with the Union Iron Works, San Francisco, Cal., and with the Navy Department at Washington. The firm will carry a complete line of Crandall packings.

EXHIBIT AT ST. LOUIS.—The Northern Electrical Manufacturing Company, Madison, Wisconsin, has an exhibition at the World's fair, demonstrating the application of Northern motors to various types of machines and tools, such as engine lathes, milling machines, grinders, shapers, bolt cutters, and disc grinders. The company states that its system involves the use of a single voltage, while giving wide range of speed in a small standard motor frame.

THE AMERICAN BUREAU OF SHIPPING, 66 Beaver street, New York city, in the *Record of American and Foreign Shipping*, reports the following vessels classed and rated: American screw *George W. Elder*, American screw *Ontario*, American schooner *Grace A. Martin*, American schooner *Margaret Haskell*, *American* schooner *Vanlear Black*, American bark *Rachel Emery*, American three-masted schooner *Joel Cook*, American three-masted schooner *Julia P. Cole*, American three-masted schooner *Mary Sanford*, American barge *Mingo*, American barge *Newburgh*, and American barge *Spring*.

RESULTS PROVE IT!

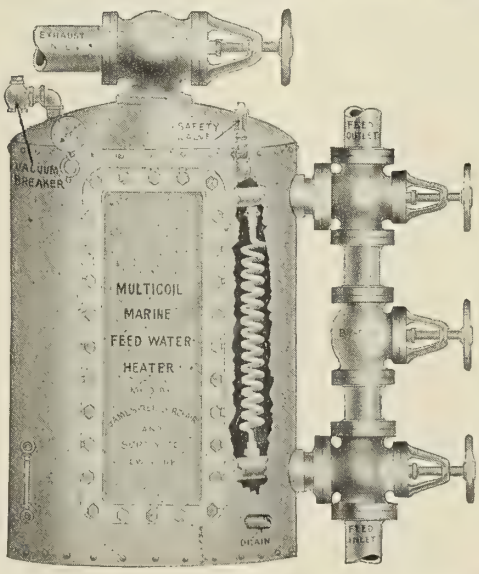
Let Us Prove It to You—
As We Have to Others Who Pay for the Coal.

Our Multicoil Feed-Water Heater IS A SUCCESS

IF YOU CANNOT KEEP UP STEAM
IF YOU CANNOT MAKE TIME
IF YOU CANNOT DEVELOP H. P.
} *OUR HEATER WILL HELP YOU*

A FEW VESSELS THAT HAVE THEM:

Monroe,
Jamestown,
Hampton Roads,
Horatio Hall,
North Star,
Middletown,
Manhattan,
Kershaw,
Powhattan,
Juniata,
Essex,
Chatham,
D. H. Miller,
Admirals Sampson and Schley,
Lighter Edgewater,
The Four New Lackawanna R. R. Ferryboats.



Asbury Park,
Sandy Hook,
Henry Wilson,
Sprigg Carroll,
Calvin Austin,
Patrol,
General Meigs,
Yachts: Celt, Carmina, Calumet, Waturus and Pioneer.
Dredges: Atlantic, Pacific, Perry, Caucus, St. John.
Government Dredges: 43, 44, 45, 46, 47, 51.

ASK US FOR A CATALOGUE.

THE JAMES REILLY REPAIR & SUPPLY CO.

229-233 WEST STREET, - - - NEW YORK CITY

Engineering specialties at the St. Louis fair.—The Lunkenheimer Company, Cincinnati, Ohio, has an exhibition of its safety valves, whistles, lubricators, injectors, oil and grease cups, and other engineering specialties in Machinery Hall, location 5-G, block 26.

New iron works.—The Quintard Iron Works have recently incorporated and will manufacture and repair, at the foot of East 12th street, New York city, steamers, marine and stationary engines and boilers, gas works machinery, sugar machinery, and machinery in general. The officers are: president, N. F. Palmer; vice-president, Stevenson Taylor; treasurer and manager, George Q. Palmer; secretary and assistant treasurer, J. M. Wellman.

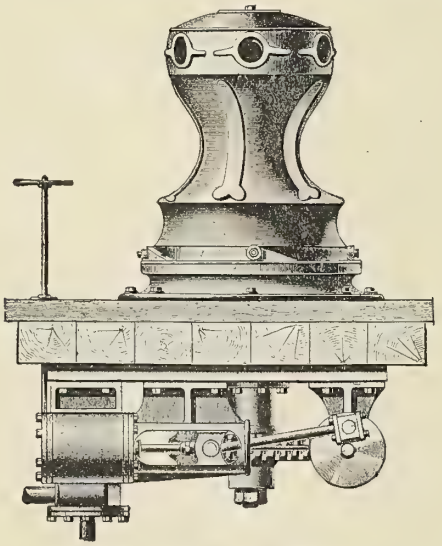
Binoculars for the Navy Department.—The Warner & Swasey Company, Cleveland, Ohio, announces that the United States Navy Department has on three occasions appointed special boards to make tests of the leading American and foreign makes of prism binoculars, and that on all three occasions the Warner & Swasey prism binoculars were adopted by the navy as a result of the report of these boards. All ships of the navy, the company states, are now equipped with its binoculars.

One hundred dollars given away.—The Federal Valve Company, 2534 Western avenue, Seattle, Wash., claims that its valve is always able to maintain an excess water pressure over steam pressure, regardless of the fluctuations of the latter, and without the use of springs, levers, or weights. The company is offering as prizes to marine and stationary engineers in the United States and Canada, the sum of one hundred dollars for articles telling how the excess pressure is obtained and maintained, together with conclusions reached regarding its operation on a battery of boilers. The money has been deposited with the Scandinavian American Bank of Seattle, to be awarded December 1, 1904, in accordance with the decision of three judges. Full particulars may be obtained upon application to the Federal Valve Company.

HERE'S A PICTURE OF OUR

STEAM CAPSTAN

With extra heavy warping barrel; one of the many **Capstans, Windlasses, Steering Engines,** and **Other Yacht and Ship Fittings** which we manufacture.



For Particulars Address

THE TEXTILE-FINISHING MACHINERY CO.

17 Exchange Place, Providence, R. I.

New York Office, 39 Cortlandt Street

MARINE ENGINEERING EMPLOYMENT BUREAU.

Full information regarding the purposes of this bureau, together with instructions regarding registration, etc., furnished upon application to Marine Engineering Employment Bureau, 17 Battery Place, New York City.

All correspondence, concerning either vacancies or situations wanted, is strictly confidential.

POSITIONS SEEKING MEN.

BOILER-SHOP FOREMAN. Must be familiar with various types of marine boilers and capable of handling repair work. Knowledge of shipbuilding and repairs will be of great advantage. File 10.

FOREMAN FOR BOAT BUILDING SHOP who has had experience in constructing new hulls, who can attend to repair work and is familiar with gas engines. File 15.

SKILLED BOAT BUILDER who has had experience in handling men, and who can attend to the hull work in large launch works. File 14.

STEAMFITTER AND COPPERSMITH acquainted with plumbing, and able to make estimates; also to take charge in a general way of plumbers, coppersmiths and steamfitters. File No. 36.

SUPERINTENDENT, DESIGNER AND FOREMAN wanted in a shop devoted to the building of small pleasure boats. File No. 35.

ACTIVE AND PRACTICAL SUPERINTENDENT for yacht, launch and boat-building works wanted. One who can take a financial interest in the business preferred. Good opportunity to become associated with a growing business in which all interested are working. File No. 38.

MEN SEEKING POSITIONS.

We have applications registered for positions as follows, and the references of each applicant have been carefully investigated:

ASSISTANT SUPERINTENDENT, ENGINEER OR ASSISTANT ENGINEER IN ENGINEERING WORKS. Age 28; single; of English birth; has British and American licenses and has had several years' sea experience. Application No. 23.

BOILER-SHOP FOREMAN. Age 35; single; many years' experience in Navy Yard and leading shipyards. Application No. 59.

CHIEF OR ASSISTANT DRAFTSMAN—ENGINE. Age 32; married; has had sea experience and several years' experence in government and private shipyards. Application No. 25.

CONSULTING ENGINEER AND NAVAL ARCHITECT. Married; born in Germany; had many years' experience in designing, drafting and surveying. Application No. 33.

DESIGNER AND DRAFTSMAN. Has had many years' experience in launch and river boat work. Designed some of the fastest river boats in the country. Application No. 61.

DRAFTSMAN, ENGINE AND BOILER. Age 30; unmarried; has Danish marine license; technical school graduate. Application No. 57.

DRAFTSMAN—HULL. Age 20; single; experienced in architectural work, but prefers marine drafting. Application No. 51.

DRAFTSMAN—HULL. Age 25; married; 9 years' experience in leading yards in drafting, testing materials, surveying, etc. Application No. 54.

DRAFTSMAN—HULL, OR INSPECTOR. Age 37; married; had experience both in government yards and private yards. Application No. 30.

DRAFTSMAN—HULL. Age 22; single; born in Norway; studied Technical schools in Norway and Germany; experience as draftsman, also as shipfitter. Application No. 31.

DRAFTSMAN—HULL. Age 25; single; born and educated in Germany; has had 7 years' experience in drafting, sea duty as engineer, and as shipfitter. Application No. 52.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
12 West 31st Street, New York.

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TRADE PUBLICATIONS.

The Akron Chilian mill, for the wet grinding of metalliferous rock, is the subject of an illustrated catalogue issued by the Wellman-Seaver-Morgan Company, Cleveland, Ohio.

Steam and water valves are illustrated in a booklet issued by the Chapman Valve Manufacturing Company, Indian Orchard, Mass. The booklet contains a list of about 400 manufacturing and power plants, public buildings, etc., which use the Chapman valves, in sizes from 1-4 inch to 72 inches in diameter, and operated by hand, air, electricity, or hydraulic power.

Marine cable ways, and cable ways for hoisting and conveying, employed in the construction of dry-docks, piers, dams, etc., and in the discharging of vessels, are concisely described and profusely illustrated in a 160-page catalogue issued by the Lidgerwood Manufacturing Company, 96 Liberty street, New York city. The halftone illustrations contained in this catalogue are very handsome pieces of work, and illustrate Lidgerwood cables in actual operation. Among the examples given are the U. S. S. collier *Marcellus* delivering coal at sea to the U. S. S. *Massachusetts,* at a distance of from 300 to 400 feet; various views show H. M. S. *Trafalgar* being coaled at sea; the Russian battleship *Retvizan,* and other naval vessels coaling at sea; traveling cable ways in canal excavation; cable ways for rebuilding the government breakwater at Cleveland, Ohio; several cable ways used in dry-dock excavations; cable ways used in dam building, bridge building, and in logging; cable ways for building gun emplacements; for discharging cargoes on the Amazon river; and a great many other uses for which the Lidgerwood cables are used all over the world. There are more than 220 halftone illustrations, every one of which is interesting and descriptive, beside a large number of line drawings. Every ship owner, or builder of ships, dams, dry-docks, locks, fortifications, or piers should send for a copy of this catalogue.

Vertical marine engines are described and illustrated in catalogue 163, issued by the American Blower Company, Detroit, Mich. Regarding the Type B engine, the catalogue states that it is of extra heavy construction throughout. The base is a solid casting of box form, dished to receive the drippings, both oil and water, and is provided with a suitable drain pipe. The main bearings are made large to resist heating and wear, are lined with babbitt metal, and are provided with ring oilers and an oil ring to prevent the oil working out along the shaft. The lower halves of these bearings are cast solid in the base with chambers to hold the oil, which are provided with sight feed oil gauges and the necessary drain cocks. The frame of the engine is of cast iron and steel. The back is of heavy iron casting to which are fastened the crosshead guides. The frame is open, giving easy access to parts requiring adjustment. The cylinder and steam chest are cast in one piece. The steam ports are ample. The valve is of the double piston type, making it perfectly balanced. The eccentric and eccentric strap are of cast iron. The piston is hollow, turned to a close fit in the cylinder, and is provided with snap packing rings. The rings are bored slightly eccentric with the outside, in order that the outward pressure on the cylinder will remain approximately uniform. They are sprung together and returned so that they will fit to start with, and are interchangeable. The crank shaft is a solid steel forging provided with counter balances of proper weight to make the engine run smoothly. Cylinder lubrication is furnished by the Detroit or the Michigan sight feed lubricator. The Rites automatic fly wheel governor or a throttle valve governor is furnished, as may be preferred. A special feature of the Rites governor is the spring leverage adjustment, the object of which is to afford as close regulation at one speed as at another.

When writing to advertisers please refer to Marine Engineering.

Wyman & Gordon, Worcester, Mass., are distributing a booklet entitled "A Few Words About Electrical Matters."

The American Steel and Wire Company, The Rookery, Chicago, Ill., is sending out a folder giving prices of steel and copper wire on spools.

A popular gasoline motor.—The Bridgeport Motor Company, Bridgeport, Conn., is issuing a booklet containing testimonials from ninety customers who have bought and operated "The Motor that Motes," and who have written the company expressing their satisfaction with the Bridgeport engines.

Four-cycle marine gasoline engines.—The Royal Equipment Company, Bridgeport, Conn., is distributing a circular illustrating and describing its gasoline engines. Regarding the 3 H. P. reversible engine the circular says that by a simple mechanism, which is a part of the engine and not an attachment, the valve movement is controlled by a lever. The workmanship of the engines is claimed to be of the best, and only the highest grade of material is used in making them.

Engine tests.—The Reeves Engine Company, Trenton, N. J., is distributing a folder showing the results of a test of one of its engines, made by Professor R. C. Carpenter, at Cornell University, Ithaca, N. Y., in August, 1904. The purpose of the tests was to determine the steam consumption, mechanical efficiency, and general behavior of the engine under various conditions of load. A description of the engine and the results of the test, which were most flattering to the makers, will be furnished upon application to the company.

Mercury plumb bobs are the subject of a leaflet distributed by the Brown & Sharpe Manufacturing Company, Providence, R. I. These bobs are made from solid steel, bored out and filled with mercury, which makes them unusually heavy in proportion to their size. An important feature is that the outside is accurately ground true with the center line, and every care is taken to have the points, which are hardened, hang true. Their comparatively small diameter allows them to be used close to corners and walls.

Yachtsmen and others interested in the subject of cheap power plants for boats calling for 25 or more horse power, will want to send to Mr. Cyrus Robinson, vice-president of the Power and Mining Machinery Company, 52 William street, New York, N. Y., for a catalogue of the American Crossley suction gas plant. These plants generate water gas which is used in gas engines, doing away with carburetters, mixers, and other troublesome devices necessary when gasoline is used. There is nothing explosive in these plants, and there is no storing of steam, gas, or anything else dangerous. It is claimed for these plants that their operation is of the greatest simplicity and efficiency. They are guaranteed to give about a horse power an hour on a pound of coal.

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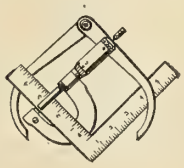

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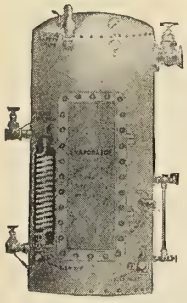

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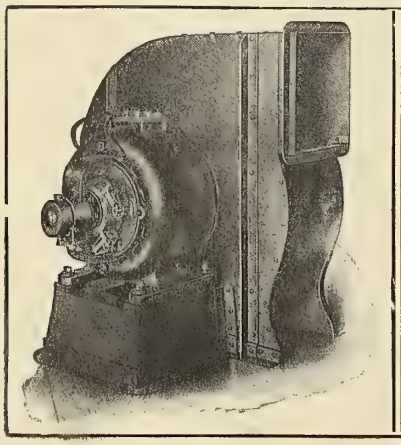

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Pneumatic hammers, drills, boring machines, air motor hoists, air compressors, and rock drills are described in illustrated circular No. 14, issued by the Rand Drill Company, 128 Broadway, New York city. Regarding the company's "Imperial" pneumatic hammers, the circular states that they strike a very hard blow, but as they cushion on live air they have practically no vibration, and therefore cause no annoyance to the operator. The valve is said to be simple, consisting of one solid cup shaped piece, and moves in the same direction as the piston, which on the upward stroke travels within the valve, giving a long stroke with a short barrel. All parts are interchangeable, and any ordinary mechanic can make the occasional repairs that may be required.

Electric light outfits for launches, yachts, house boats, private residences, etc., are illustrated and described in a 56-page catalogue issued by the Richardson Engineering Company, Hartford, Conn. Automobile charging plants, steam engine and boiler outfits, steam generator sets, and search lights are also described in this catalogue. Regarding the company's electric light outfit the catalogue states: "We have all appreciated the advantages of electric light for boats, on account of its healthfulness, cleanliness, and safety, with no odor, and almost no heat. We have a complete line of electric light outfits suitable for craft of any kind and size. No boat need be without its electric lights, as our system enables even the smallest to have its complete outfit."

Tackle blocks, wood, wrought iron, and steel are described and illustrated in an 84-page catalogue issued by the Western Block Company, Lockport, N. Y.

Electrical machinery is the subject of an illustrated 60-page catalogue issued by the Triumph Electric Company, Cincinnati, Ohio.

Electrically welded screws are the subject of a folder issued by the Cleveland Cap Screw Company, Cleveland, Ohio. This folder says: "The electric welding process, as applied to screw manufacture, is original with us, and we have been using it successfully for two years."

Yacht and marine plumbing specialties are illustrated and described in a 65-page catalogue issued by Alfred B. Sands & Son, 134 Beekman street, New York city. Any one interested in this line of work should not fail to send for a copy.

Shipbuilders and yachtsmen interested in the subject of dead lights, deck lights, ventilators, coaling scuttles, pumps, bitts, hose, windlasses, capstans, winches, and other marine supplies should send for Catalogues A and B, issued by the Marine Manufacturing and Supply Company, 157 South street, New York city.

Lubricators and lubricating devices for steam, gas, and gasoline engines are described in illustrated Catalogue No. 2, issued by the G. B. Essex Brass Company, Detroit, Mich. Among the many devices of this nature described are double sight-feed lubricators for compound engines and high pressure cylinders, sight-feed lubricators for gasoline engines and air compressors, automatic multifeed oilers, oil pumps, grease cups, globe valves, angle valves, etc.

Induced draft for boilers.—Mr. W. Carlile Wallace, 22 Thames street, New York city, American representative of John Brown & Co., Birmingham, England, manufacturers of corrugated furnaces and induced draft apparatus, is distributing a folder showing the results of tests of the Ellis & Eaves system of induced draft fitted to Scotch and water tube boilers. These tests show great increased efficiency and economy over natural draft, without injury to the furnace, as is apt to be the case when forced draft is used. A copy of the circular may be obtained upon application to Mr. Wallace.

Duplex compound engines, manufactured by the American Engine Company, Bound Brook, N. J., are the subject of an illustrated folder distributed by the company. The folder states that this engine requires no more floor space than the most compact simple engine, and that it has fewer parts than any other compound engine. These engines are in use in the plants of the American Steel and Wire Company, at Worcester, Mass., Cleveland, Ohio, Joliet, Ill., Anderson, Ind., and Waukegan, Ill.; in the Baldwin Locomotive Works, Philadelphia, Pa.; in the United Gas Improvement Company's plant at Philadelphia, and in many other well-known manufacturing plants.

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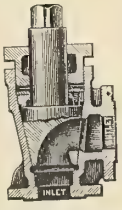

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BUSINESS NOTES.

A MATCH SAFE SENT FREE.—The Detroit Leather Specialty Company, Detroit, Mich., will send free to every reader of MARINE ENGINEERING, upon request, a neat leather match safe to carry in the pocket, the only condition being that MARINE ENGINEERING be mentioned in the request.

LIDGERWOOD MARINE CABLEWAYS IN RUSSIA.—Mr. Spencer Miller, chief engineer of the Lidgerwood Manufacturing Company, New York city, has returned from St. Petersburg, Russia, where he went by request of the Russian government to inspect ten Lidgerwood marine cableways which had been installed upon the ten largest battleships and cruisers of the Baltic fleet.

ELECTRICAL CONTRACT AWARDED.—The Northern Electrical Manufacturing Company, Madison, Wis., has been awarded the contract for the entire motor equipment of the new shops of the Southern Railway Company at Spencer, N. C. About 450 H. P. of motors will be required. A combination of group and individual drive will be used, and all motor driven tools requiring speed variations are to be equipped with Northern two-wire variable speed motors. A Northern 50 Kw. generator will also be used for lighting the Southern Railway Company's shops at Alexandria, Va.

THE SURVEYING AND DRAFTING INSTRUMENTS, devices for automatic calculating, blue printing material and apparatus, nautical instruments, measuring tapes, etc., manufactured by the Keuffel & Esser Company, 127 Fulton street, New York city, are on exhibition in Block 43, Palace of Liberal Arts, at the World's Fair, St. Louis. These articles are displayed in and about an ornamental pavilion, and the nautical instruments are on an imitation ship with a pilot house. The exhibition is artistically arranged and occupies more than 1,500 square feet of floor space.

PREVENTION OF FLAWS IN STEEL CASTINGS.—The Goldschmidt Thermit Company, 43 Exchange place, New York city, claims that the use of its Lunker-thermit will prevent flaws in steel castings. The company states that such flaws occur in most cases under the rising header, in consequence of the steel cooling at that part before the body of the casting. In order to prevent this a box of Lunker-thermit is placed at the bottom of each rising header. The molten steel will have cooled considerably at these points, but will be sufficiently hot to ignite the thermit. The reaction reheats the steel, rendering it fluid, and the liquid steel flows back out of the rising head in sufficient quantities to replace shrinkage and to fill up any cavities which may have been formed.

A COURSE IN INDICATOR INSTRUCTION.—The Indicator Instruction Company, Scranton, Pa., has for fifteen years made a specialty of teaching the use of the steam engine indicator by correspondence. The company's original plan was to loan an indicator to students, while the course of instruction lasted, but there were so many applications from those who desired to own the instrument that the company now gives away a simple form of indicator to each student. A thorough knowledge of the use of the steam engine indicator is indispensable to any engineer who hopes to rise in his profession. The indicator tells the horse power developed; whether or not the boiler pressure is realized in the engine cylinder, and if not how much pressure is lost, due to a steam pipe too long or having too many bends, or from late or insufficient valve opening; whether waste steam is permitted to escape without undue back pressure; whether the work done by the head and crank ends of the cylinder and the high and low pressure cylinder of a compound engine is evenly balanced; whether there is any leakage by valves or piston; whether the engine is over loaded or under loaded; whether a larger engine should be used; and many other points the knowledge of which is essential for procuring the utmost efficiency of a steam plant. The Indicator Instruction Company states that its course is so simple that a man of very moderate education can readily master it. Particulars upon application.

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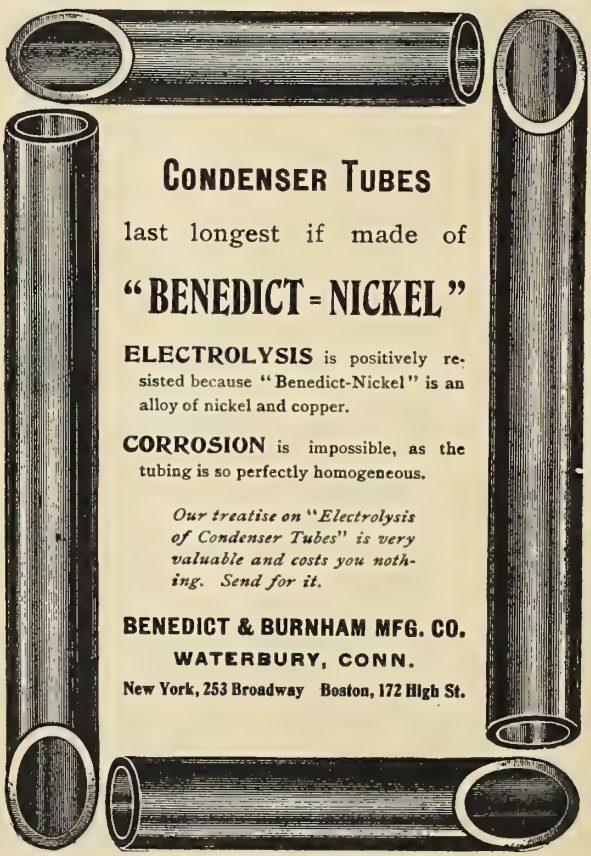

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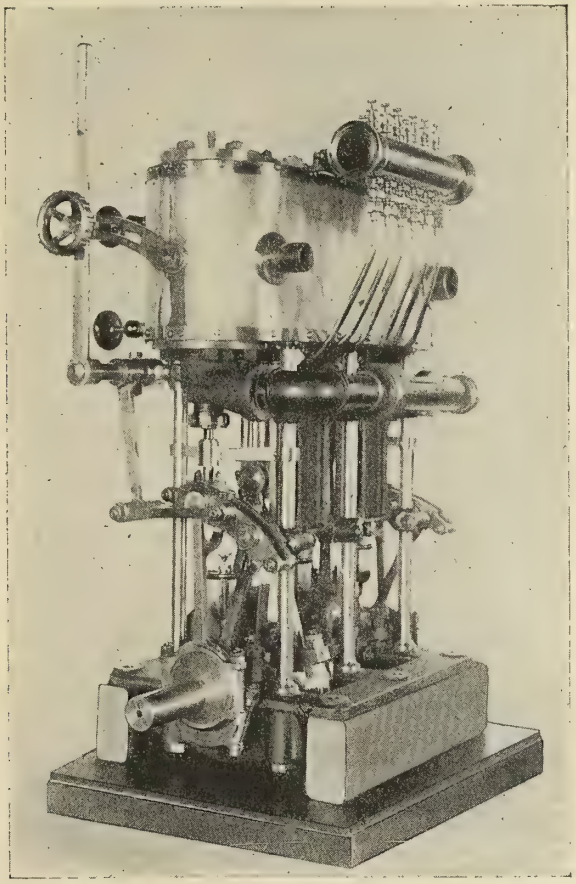

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Circulars of this Engine as well as of our Steering Engine and Engine for direct-connected purposes forwarded on application.

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Second-hand gasoline engines.—The Mianus Motor Works, Mianus, Conn., is offering for sale second-hand gasoline engines of several well-known makes at greatly reduced prices. A list will be sent upon application.

Don't buy what you don't want

but ask for what you do want

through our

INFORMATION BUREAU . . . .

Steel casting plant.—The National Steel Foundry Company, 114 Liberty street, New York city, announces that it now has in operation a completely equipped plant for making open-hearth steel castings, and is prepared to deliver all orders promptly.

Meteor steering gears.—The Edson Manufacturing Company, 255 Atlantic street, Boston, Mass., has received an order from W. Gould Brokaw, New York city, for a Metor steering gear for his yawl *Sybarita.* This is the same style of gear as that furnished by this company for the yacht *Meteor,* belonging to the emperor of Germany.

Every builder of oil or gasoline engines will be interested in the new engine cock made by the Globe Brass Works, Detroit, Mich. This cock is of an extra heavy weight composition metal, specially ground to stand the gasoline test. The company states that it is meeting with great success. The Globe Brass Works make also steam, gas, gauge, air, and meter cocks; safety, lock, shield, and needle valves; gas mixers; water gauges; ground key bibbs; gasoline fire pots; torches, and other engineers' supplies.

The failure of dial thermometers to satisfy the navy department is evidenced by a recent order to government contractors for United States war vessels to substitute mercurial thermometers of the Hohmann & Maurer type, manufactured by the Hohmann & Maurer Manufacturing Company, Rochester, N. Y. This company makes thermometers and gauges designed especially for marine use. Among the types manufactured are hot well thermometers for feed and injection pipes, scale case thermometers for high pressure steam, superheated steam thermometers and brine pipe thermometers. This company also makes marine barometers and other nautical instruments.

Science reference room.—The Pratt Institute Free Library, Ryerson street, Brooklyn, N. Y., has opened an applied science reference room, devoted to technical and trade literature. It is in charge of Mr. Herbert L. Cowing, a graduate of the mechanical engineering course of Cornell university, and is open every day from 2 until 6, and on Monday, Wednesday, and Saturday evenings until 9:30. The institute wishes to collect trade catalogues and bulletins bearing upon all branches of industry. These catalogues will be accessible to the public; and the institute asks advertisers in Marine Engineering to forward their catalogues and trade literature.

A compact steam capstan windlass.—The Textile Finishing Machine Company, 17 Exchange place, Providence, R. I., makes the claim regarding its steam capstan windlasses that they require about one-half the space occupied by many similar machines; that the capstan runs independently of the windlass when desired, being arranged to work as a power capstan by hand when without steam. The locking key is always in sight, so that in an emergency it can be seen whether the windlass is locked, without stopping to try it. The windlass may be driven either way without reversing the engines, and may also be rolled in or out by taking off bitt caps without distributing any other part of the machine.

A new high pressure packing ring.—The New Jersey Asbestos Company, Camden, N. J., is putting on the market a new packing ring. The company states that this packing is not made by cutting a piece of packing the required length and pressing it in a mandrel until it stays circular in form resembling a ring, but that it is actually molded to shape in steel dies under hydraulic pressure, which makes it almost as solid as though it were made of metal, but without destroying its flexibility. The solidity of the rings, so it is claimed, prevents their blowing out. These rings are made of the same material as the company's "Gladiator" asbestos metallic packing, and are made in many sizes. Any special size desired will be made to order. Any reader of Marine Engineering will receive a free sample ring upon application to the manufacturer.

The Northern Electrical Manufacturing Company, Madison, Wis., has sold to the New York Edison Company, New York city, thirty-four variable speed motors operated on the Northern two-wire field control system. These motors will be direct connected to blowers for cooling the transformers in the company's sub-stations. The New York Edison Company has also purchased from the same manufacturer a sixty Kw. balancing set.

The Mosher Water Tube Boiler Company, 1 Broadway, New York city, a full description of whose boiler appeared in the January, 1904, issued of Marine Engineering, claims that its boiler is the simplest type of the water-tube boiler, as it consists of a steam drum supported by slightly curved tubes which connect it with two water drums, with furnace and grate bars between. A very simple form of feed-water heater, ease in cleaning or removing the tubes, an improved system of circulating the feed water, safety, the absence of staybolts, braces and flat surfaces, economy, durability, and steadiness of water and steam pressure are among the advantages claimed for this boiler.

Brown corrugated furnaces.—Readers of Marine Engineering will recall reading an article last year describing the tests made in Philadelphia of the Brown corrugated furnace. These tests are now bearing fruit, as the American Corrugated Furnace Company has been incorporated to manufacture this furnace in the United States. Heretofore, they have been imported, and consequently have been subject to the usual delays and the tariff charges. This plant has been constructed with a view to making furnaces of larger sizes than have yet been built, and also heavy pressed steel work. Mason G. Worth & Company, Philadelphia, Pa., report that they have imported quite a number, and that it is in response to the demand of the shipbuilders that this company has begun business.

Falls hollow staybolts.—Mr. John Livingstone, an engineering expert of Montreal, Canada, writes the Falls Hollow Staybolt Company, Cuyahoga Falls, O., regarding the company's claim that its hollow staybolt iron is the only elastic staybolt iron in the world: "At no stage in the manufacture of iron, from the ore to the rolls, is iron flexible or elastic. It is in its different stages crystalline, brittle, fluid, fibrous, ductile, but never elastic. The iron is ductile and its nature cannot be changed except by its union with carbon. In that way you change the breed and make steel. It is because your bolt is hollow from end to end that a concentrated current of air (which is elastic) passes through it, that you make the claim." Mr. Livingstone writes at full regarding many other points of superiority which the Falls Hollow Staybolt Company claims for its product, and anyone interested in the subject should write for a copy of his letter, which will be sent upon application.

POWELL PATENT "SIGNAL" OILER

AS RECONSTRUCTED
FOR HIGH-GRADE, HIGH-CLASS ENGINES

Signal Lever Up—Oil Dropping
Signal Lever Down—Dropping Stopped

Convenient to fill. Easy to regulate. When once the required rate of feed is obtained it need never be disturbed. If desired to stop the flow of oil, simply drop the lever, as shown by the dotted lines; to again start the flow, raise lever to an upright position. A first-class, reliable Oiler in every sense of the word.

THE WM. POWELL CO.

Manufacturers of Everything in the Steam Line for the Boiler and Engine Room.

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A Chance Courtship

is a story of an unconventional love match, well told and beautifully illustrated. As a bit of readable fiction the story is well worth writing for. It is contained in a handsomely bound book of 128 pages, a portion of which is devoted to the attractive mountain and lake resorts along the Lackawanna Railroad. It is a book you will like to see. It may be had by sending 10 cents in postage stamps to T. W. Lee, General Passenger Agent, Lackawanna Railroad, New York.

UNITED STATES METALLIC PACKINGS

FOR PISTON RODS AND VALVE STEMS OF MAIN AND AUXILIARY ENGINES

RELIABLE—SATISFACTORY—EFFICIENT

The United States Metallic Packing Co.

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MOTOR BOAT AND SPORTSMAN'S SHOW

MADISON SQUARE GARDEN, NEW YORK CITY
FEBRUARY 21 TO MARCH 9, 1905
Address, J. A. H. DRESSEL, General Manager, 1135 Broadway, N. Y.

PORT LIGHTS OF ANY TYPE OR SIZE, for all classes of vessels, are made a specialty by the Delaware Marine Supply Manufacturing Company, Wilmington, Del. This company also manufactures ship fittings in brass, bronze, or other compositions, cleaks, chocks, vents, scuttles, marine hardware, white bronze, and special compositions.

DROP FORGED FOLLOWER PLATE.—The Allegheny Forging Company, Pittsburg, Pa., has placed on the market a design of drop forged, one piece follower plate for spring draft gears. It is lighter than the riveted thimble plates usually used, and saves the expense of drilling the riveted hole, countersinking and riveting the thimble to the plate. It is claimed that trouble with broken rivets or thimbles is not experienced with these followers.

A SATISFACTORY MARINE PLANT.—The Herzog Paint and Varnish Company, Philadelphia, Pa., has received the following letter from F. M. Johnson, master of the steam yacht *Narwhal*, New London, Conn.: "We hauled out the *Narwhal* after being in the water from May to September. Your green anti-fouling paint, which we used the past season, gave better satisfaction than any paint we ever used. The bottom was clean as the day she was launched in May, showing no signs of grass, barnacle, or corrosion. Every one who saw the boat said it was the cleanest they had seen for the time she was in the water, several asking whose paint we used. I referred them to your company. There was really no need of hauling out this fall. I shall be pleased to recommend your paint where I can."

DE LAVAL TURBINE BLOWERS.—Bulletin No. 6, issued by the De Laval Steam Turbine Company, Trenton, N. J., states that blowers of the Sturtevant and Sirocco types have proved particularly successful when direct connected to De Laval steam turbines. In many classes of work where high pressures are required it has been found impossible to keep blower belts tight and in good running condition, so the bulletin states. It has usually been necessary to mount the blower on a sliding base to maintain the proper belt tension, producing large frictional losses. Even with the belts in the best condition, the service is such that it has been found difficult to maintain the proper speed and rated capacity of belted blowers. With machines of considerable size a solid foundation is required for both blower and engine, and with the long belt centers necessary, the room occupied is considerable. The De Laval direct connected turbine blower set lends itself particularly to this class of work, being perfectly balanced, self-contained, and having an ideal speed for this purpose. The regulation is extremely close. There are no adjustable parts on the machine and no belts to cause trouble. The amount of care required is reduced to a minimum; but little in the way of foundation is necessary, and machines can be used in the upper stories of buildings or any desired place.

STEEL HULLS FOR MOTOR BOATS.—W. H. Mullins, Salem, Ohio, is placing on the market 16 and 18-foot stamped steel hulls for motor launches. Mr. Mullins states that these hulls are guaranteed not to leak, and that the constant jar and concussion of the engine will not rack them in the least. Those interested will receive a free catalogue upon application.

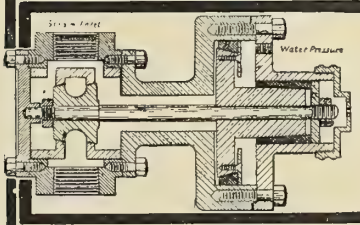
MAGNESIA PIPE COVERINGS AT THE WORLD'S FAIR.—The Philip Carey Manufacturing Company, Lockland, O., states that it 85 per cent. magnesia pipe coverings are used for insulating all the connections of the main power plants at the St. Louis exposition. This company has an elaborate display in Machinery Hall. It has recently issued a complete catalogue of its products, a copy of which will be sent upon request.

HOSPITAL IN MANUFACTURING PLANT.—The B. F. Sturtevant Company, Hyde Park, Mass., manufacturer of ventilating machinery, forced-draft apparatus, fuel economizers, generating sets, etc., is fitting up quarters in its new plant to be used as an emergency hospital in case of accident to employes. It is to be equipped with all the appliances necessary for the proper care, until they can be removed to their homes, of men who are injured while at work. A trained nurse and a medical student will be in charge, and a local surgeon will attend to surgical cases.

THERMIT IN THIS COUNTRY.—The Goldschmidt Thermit Company, 43 Exchange Place, New York city, announces that it has completed arrangements for the manufacture of thermit in this country, and that this new welding process has already been adopted in the United States by a large number of steel works to repair defective castings, by a dozen railway companies for repairing engine frames and drivers, and by six street railway companies for obtaining a continuous rail. At the St. Louis fair the Goldschmidt Thermit Company has an exhibition in the Metals Pavilion, opposite the southeast corner of the Mines and Metallurgy building. Daily demonstrations of this welding process are there given.

A RELIABLE FIRE EXTINGUISHER.—The New York office of Hollander & Tangeman, manufacturers of F. I. A. T. auto boats, writes the H. W. Johns-Manville Company, 100 William street, New York city, as follows: "We confirm our request by telephone that you send someone to refill extinguishers just emptied by our men. A fire started in the rear of our garage, caused by one of the employees throwing some oily waste into the stove at a time when there was gasoline about the floor being used for cleaning purposes, causing the flame to issue through the stove door. In a few seconds the floor was ablaze. Fortunately there were a number of men on the spot, who immediately made use of your extinguishers, with the result that what looked at first to be a very serious fire, was extinguished in a few minutes. We are entirely satisfied with the results which you claim for them."

MULLINS AUTOMATIC CONTROLLER



...FOR BOILER FEED PUMPS...

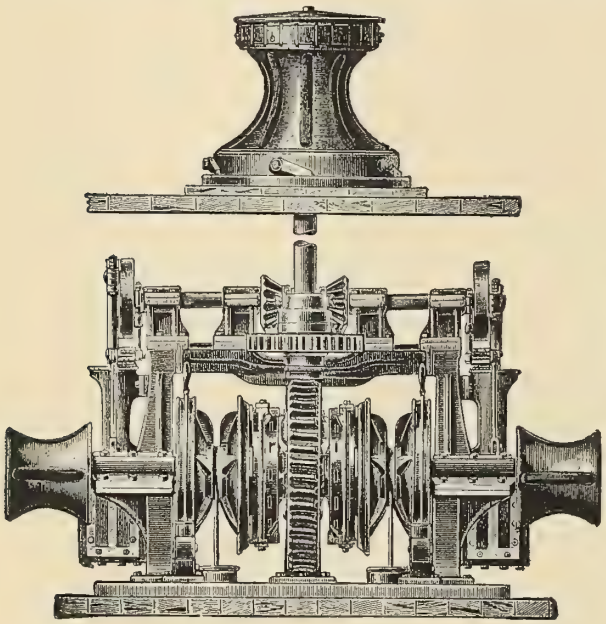
Delivers more water to boilers when steam-pressure is high, and less when it is low, which not only holds the water uniform, but also tends to hold steam pressure uniform, saving fuel that is wasted in pumping too fast and flooding boilers when fires are low. It will outlive any pump, and increase the life of the pump one-half. WRITE US FOR DETAILS.

THE FEDERAL VALVE CO., 2534 WESTERN AVE. SEATTLE, WASH

A REORGANIZATION.—The Seamless Steel Tubes Company, Detroit, Mich., has been reorganized under the name of the Detroit Seamless Steel Tubes Company, and will continue the manufacture of cold drawn seamless steel boiler tubes, automobile axle tubing, and mechanical tubes.

ACETYLENE LIGHTING for yachts and other steam and sailing vessels is described in a catalogue issued by the Commercial Acetylene Company, 80 Broadway, New York city. The following reasons are given to sustain the company's claim that acetylene lights are the best for marine purposes: First. The quality of the light is more nearly like sunlight than that produced by any other system. It is especially adapted to interior illumination, and is giving satisfactory results in binnacle and running lights, as well as in searchlights of high power and penetration. Second. The quantity of acetylene used in a gas jet is one-tenth the amount of ordinary gas that would be used in the same burner, and produces 50 per cent. more candle power. Third. It is safer than any other form of lighting, because of the small quantity used. A jet carelessly left open would not emit enough gas, even in a small room during an entire night, to cause asphyxiation or to produce an explosion. The strong pungent odor of acetylene will instantly make apparent any leak that may occur. Fourth. The small quantity of gas burned (one-half of one cubic foot per hour) makes a small compact flame which cannot be blown out, even in a gale of wind, and which therefore can be used out-of-doors as readily as an electric lamp. At the Buffalo exposition in 1901, the outside of an entire building was decorated with acetylene jets, which burned in the open air in all kinds of weather, and which were not affected by gales or rain; while their great brilliancy added perceptibly to their decorative effect in comparison with the adjoining buildings, the exteriors of which were decorated with electricity.

STEERING GEAR
WINDLASSES, CAPSTANS



AND OTHER SHIP AND YACHT FITTINGS

The Textile-Finishing Machinery Co.

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NEW YORK OFFICE, 39 CORTLANDT STREET

MARINE ENGINEERING EMPLOYMENT BUREAU.

Full information regarding the purposes of this bureau, together with instructions regarding registration, etc., furnished upon application to MARINE ENGINEERING Employment Bureau, 17 Battery Place, New York City.

All correspondence, concerning either vacancies or situations wanted, is strictly confidential.

POSITIONS SEEKING MEN.

BOILER-SHOP FOREMAN. Must be familiar with various types of marine boilers and capable of handling repair work. Knowledge of shipbuilding and repairs will be of great advantage. File 10.

FOREMAN FOR BOAT BUILDING SHOP who has had experience in constructing new hulls, who can attend to repair work and is familiar with gas engines. File 15

GAS ENGINE BUILDER wanted to combine his business with a boat building and repairing shop which has marine railways and an established business. File 40.

SHEET IRON WORKERS, erecting machinists, and steam fitters wanted who have had experience in marine work. File No. 42.

SKILLED BOAT BUILDER who has had experience in handling men, and who can attend to the hull work in large launch works. File 14.

STEAMFITTER AND COPPERSMITH acquainted with plumbing, and able to make estimates; also to take charge in a general way of plumbers, coppersmiths and steamfitters. File No. 36.

SUPERINTENDENT, DESIGNER AND FOREMAN wanted in a shop devoted to the building of small pleasure boats. File No. 35.

ACTIVE AND PRACTICAL SUPERINTENDENT for yacht, launch and boat-building works wanted. One who can take a financial interest in the business preferred. Good opportunity to become associated with a growing business in which all interested are working. File No. 38.

YACHT AND BOAT BUILDER wanted who understands inside joiner work and who is able to superintend the building of launches and yachts under all the branches. File No. 39.

MEN SEEKING POSITIONS.

We have applications registered for positions as follows, and the references of each applicant have been carefully investigated:

ASSISTANT SUPERINTENDENT, ENGINEER OR ASSISTANT ENGINEER IN ENGINEERING WORKS. Age 28; single; of English birth; has British and American licenses and has had several years' sea experience. Application No. 23.

BOILER-SHOP FOREMAN. Age 35; single; many years' experience in Navy Yard and leading shipyards. Application No. 59.

CHIEF OR ASSISTANT CHIEF DRAFTSMAN—ENGINE. Age 33; married; has had sea experience and thirteen years as leading and chief draftsman of private and government shipyards. Application No 25.

CONSULTING ENGINEER AND NAVAL ARCHITECT. Married; born in Germany; had many years' experience in designing, drafting and surveying. Application No. 33.

DESIGNER AND DRAFTSMAN. Has had many years' experience in launch and river boat work. Designed some of the fastest river boats in the country. Application No. 61.

DRAFTSMAN, ENGINE AND BOILER. Age 30; unmarried; has Danish marine license; technical school graduate. Application No. 57.

DRAFTSMAN—HULL. Age 20; single; experienced in architectural work, but prefers marine drafting. Application No. 51.

DRAFTSMAN—HULL. Age 25; married; 9 years' experience in leading yards in drafting, testing materials, surveying, etc. Application No. 54.

DRAFTSMAN—HULL, OR INSPECTOR. Age 37; married; had experience both in government yards and private yards. Application No. 30.

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Advisory Board, WM. J. DU BOIS, 23 Second Ave., New Brighton; JOSEPH BROOKS, 6323 Dicks Ave., Philadelphia, Pa.; WILLIAM SCHEFFER, 1049 W. Hopkins Ave., Baltimore, Md.

ADDRESSES OF CORRESPONDING SECRETARIES.

No. 1, W. D. Blaicher, 10 Exchange St., Buffalo, N. Y.
" 2, Wm. Kelly, 11 Wall St., Cleveland, O.
" 3, A. L. Jones, 289 Champlain St., Detroit, Mich.
" 4, Jas. A. Macauley, 5802 Indiana Ave., Chicago, Ill.
" 5, Otto Boettger, 1035 E. Hopkins Ave., Baltimore, Md.
" 6, Wm. Arste, 322 Pine St., St. Louis, Mo.
" 7, Wm. T. McElwee, Box 1556, Portland, Me.
" 9, Wm. Bridges, 784 1-2 12th St., Milwaukee, Wis.
" 13, John G. Paulding, 1746 Tulip St., Philadelphia, Pa.
" 14, Joseph F. Dumas, 403 Dauphin St., Mobile, Ala.
" 15, R. L. Skinner, 622 Louisa St., New Orleans.
" 17, Jas. D. Robinson, 6th and Columbia Sts., Newport, Ky.
" 18, Wm. Hurst, 715 Walnut St., Cairo, Ill.
" 20, Jos. B. Barry, 206 Keel St., Memphis, Tenn.
" 21, J. H. Foley, 206 N. Mulberry St., Vicksburg, Miss.
" 23, Wm. R. Lewis, 213 E. Front St., Jeffersonville, Ind.
" 24, Hugh L. Edwards, 511 Washington St., Paducah, Ky.
" 26, T. H. Kirkbride, 228 Bond St., Evansville, Ind.
" 27, L. C. Schwall, 598 S. Madison St., Bay City, Mich.
" 29, James R. Sutherland, Charleston, W. Va.
" 30, E. R. Humphrey, 21 State St., Pittsburg, Pa.
" 33, James J. Waters, 283 Hudson St., New York, N. Y.
" 35, William M. Coombs, 36 East St., San Francisco, Cal.
" 36, Jos. Thomas, 57 Sea St., New Haven, Conn.
" 37, John B. Bender, 1215 Evesham Ave., Toledo, Ohio.
" 38, C. H. Wolford, 73 Starr Boyd Bldg., Seattle, Wash.
" 39, Frank Feeney, 460 E. 12th St., Erie, Pa.
" 40, Chas. Drouet, 1003 Ave. I, Galveston, Tex.
" 41, W. H. Marshall, 343 Holladay St., Portland, Ore.
" 42, Jas. Manning, 802 E. Duval St., Jacksonville, Fla.
" 43, A. J. Wilson, 1327 La Peer Ave., Port Huron, Mich.
" 44, Chas. J. Sullivan, 480 1st St., Manistee, Mich.
" 45, W. L. Salter, Care O. S. S. Co., Savannah, Ga.
" 46, D. W. Farrell, Clayton, N. Y.
" 47, J. R. Cook, Sault Ste. Marie, Mich.
" 48, Alfred Hegemer, 140 E. Park St., Sandusky, O.
" 51, H. S. Connell, 12 Ransom St., Muskegon, Mich.
" 53, Harry Stone, Box 445, Marine City, Mich.
" 55, Archie Stalker, Box 883, Cheboygan, Mich.
" 57, E. B. Meeker, 71 Abeel St., Kingston, N. Y.
" 58, E. Capers Haselden, Box 31, Georgetown, S. C.
" 59, Geo. F. Keating, 74 Webster St., E. Boston, Mass.
" 62, N. S. Lawrence, 30 Connecticut Ave., New London, Conn.
" 63, M. J. Burke, 152 Sheridan Ave., Albany, N. Y.
" 65, W. C. Palmer, Care Consumers' Coal Co., Charleston, S.C.
" 67, James K. Dole, Saugatuck, Mich.
" 70, Chas. T. Smith, 665 Commercial St., Astoria, Ore.
" 72, Wm. T. Findlay, 130 W. Bridge St., Oswego, N. Y.
" 73, E. M. Donahue, 1308 Cherry St., Green Bay, Wis.
" 75, Wm. D. Hemenway, Alexandria Bay, N. Y.
" 76, Orson Vanderhoef, Grand Haven, Mich.
" 77, John P. Hall, 1215 Huron St., Manitowoc, Wis.
" 78, J. P. Burg, 2722 Minnesota Ave., Duluth, Minn.
" 80, Edward S. Welch, 338 Hamilton St., Albany, N. Y.
" 81, Jas. L. Sweeney, 206 E. Sarragosa St., Pensacola, Fla.
" 82, Fred H. Gowell, 427 Middle St., Bath, Me.
" 85, John A. Packard, 623 Merchant St., Alpena, Mich.
" 86, Sherman A. Smith, 737 Menekaunee Ave., Marinetta, Wis.
" 87, Geo. B. Milne, 809 Fourth St., Detroit, Mich.
" 88, C. O. Chapman, S. B. Canal, Sturgeon Bay, Wis.
" 89, Geo. E. Willard, 4 Isabella St., Ogdensburg, N. Y.
" 91, A. L. McLaren, 130 W. Walnnt St., Ashtabula, O.
" 92, Jos. D. Budd, Box 50, Sta. I, Saginaw, W. S., Mich.
" 93, W. J. Cook, 2220 G. St., N. W., Washington, D. C.
" 94, Geo. R. Jones, Box 222, Washington, N. C.
" 95, P. J. McMahon, Box 199, Key West, Fla.
" 98, C. N. Vosburg, 6323 Patton St., New Orleans, La.
" 100, H. F. Mocine, Honolulu, H. I.
" 101, J. K. Cotton, Box 765, Norfolk, Va.
" 102, Fred W. Linsemeyer, 210 Clinton St., South Haven, Mich.
" 103, A. E. Pittman, Box 378, New Bern, N. C.

TRADE PUBLICATIONS.

"The Preservation of Ships by Electrically Operated Doors and Hatches of the 'Long Arm' System," is the title of Bulletin No. 8, issued by the "Long Arm" System Company, Cleveland, Ohio.

Barr outside centre packed pumps.—A mailing card issued by the Barr Pump Company, Lehigh avenue and 18th street, Philadelphia, Pa., says: "There may be pumps made as strong as the Barr pumps, but none are stronger. There may be workmanship as thorough as the Barr workmanship, but none any better. Do you wish to have our new catalogue on file? Sent on request only."

Turner carbureters.—The Turner Brass Works, Franklin and Michigan streets, Chicago, Ill., have received the following letter from A. F. Meisselbach & Bro., 22 Prospect street, Newark, N. J.: "Kindly send us one of your latest Turner carbureters with one-inch intake for a 14-H.P. Buffalo engine. We have induced quite a few other people to use your carbureter, especially those using a Buffalo engine. Ours is giving splendid satisfaction."

A modern battleship is illustrated and its parts minutely described in an engraving three feet long published by the Derry-Collard Company, 256 Broadway, New York city. There is an index to nearly 500 parts. This engraving is said to be from a drawing by one of the best mechanical illustrators in the country, and to represent two years of draftsmanship of the highest order in conjunction with naval experts. Any one interested in studying problems that must be solved in battleship building should send fifty cents for a copy of this engraving.

Steam pumps are described and illustrated in a 52-page catalogue issued by the A. S. Cameron Steam Pump Works, foot of E. 23d street, New York city. This catalogue states: "If you are seeking a pump that is cheap and nothing else, we have to say that we do not attempt to compete in price with the cheaper and short-lived pumps. Our policy, steadfastly pursued since the beginning of our business, has been to build the very best pump that good material and skilful workmanship can produce." Among the valuable qualities the makers claim for this pump are simplicity, durability, and absence of outside valve gear or moving parts. The catalogue exhaustively describes many of the pumps made by the company, and any one interested in the subject should not fail to send for a free copy of the catalogue.

Smooth-on iron cement, for marine engines and boilers, gas and oil engines, steel and iron construction, and engineers' and machinists' work of all kinds, is the subject of a 100-page catalogue issued by the Smooth-On Manufacturing Company, 572 Communipaw avenue, Jersey City, N. J. Smooth-On is a plastic iron compound that metallizes and becomes a part of the casting or other iron into which it is introduced. It is sold in powdered form, and in order to use it all that is necessary is to make a thick putty with water and apply the mixture to whatever part of the casting is defective. In a few hours a chemical change has converted it into iron and the defective part may be finished the same as any other part of the casting, leaving a smooth, hard surface the same color as the casting. The repair is permanent and the Smooth-On may be chipped, filed, and treated in every way like the original metal. Smooth-On is claimed to be extremely valuable for boiler patches being used by engineers, ship builders, and the United States government in place of white and red lead and iron borings. There are many illustrations in the catalogue showing repairs made with Smooth-On to pumps, castings, flanged joints, steam pipe leaks, etc. Many testimonial letters from prominent engineers are reproduced, and no one interested in the subject should fail to send for a free copy of the catalogue. The company's new product, Smooth-On sheet packing is also described.

Graphite for the motor is the title of a booklet issued by the Joseph Dixon Crucible Company, Jersey City, N. J. Those interested in the subject of lubrication for gasoline motors and automobiles would do well to send for a free copy of this booklet.

Marine boilers, boiler plates, steel shafts, generating sets, slow speed motors, electric hoists, and other machinery, are described in a folder issued by the Portland Company, Portland, Me. This company is an outgrowth of the Portland Locomotive Works. Its plant has been enlarged and fitted with the latest patterns of air, electric, and hydraulic tools.

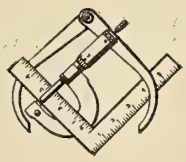
An improved liquid for hydraulic jacks.—The Watson-Stillman Company, 46 Dey street, New York city, is mailing a folder calling attention to its "Jackohol," a new liquid for hydraulic jacks. The folder states that hydraulic jacks are frequently injured by the use of impure liquids. The company has experimented with many liquids for this use. Various formulas have been tried in order to obtain an anti-freezing liquid which would prevent rust and corrosion and not injure leather packings. After several years of experimenting the company has placed on the market its new liquid, "Jackohol," which, it states, not only fulfils all the necessary requirements, but only costs about half as much as the standard formula generally in use.

Producer gas, its uses and cost, is the title of a 16-page pamphlet issued by the Wile Power Gas Company, Cutler building, Rochester, N. Y. This pamphlet states that "producer gas is the cheapest form of energy from fuel and is made in gas producers. It is is used as a motive power for driving gas engines, and also extensively as fuel for heating and furnace work. Any class of fuel can be used in our gas producers, but in small plants anthracite coal, coke or charcoal would be preferred. Producer gas is made by passing a mixture of steam and air through an incandescent fuel bed in a closed producer. The fuel in the producer is converted into fixed gases and only the ashes remain." Those interested should send for a free copy of the Wile Power Gas Company's catalogue.

Valveless gasoline marine motors are the subject of an illustrated catalogue issued by the Lackawanna Valveless Motor Company, 1268 West avenue, Buffalo, N. Y. The Lackawanna motors operate on the two-cycle principle. The catalogue states that the absence of springs, gears, cams, levers, valves, and push rods makes them simple, reliable, and long lived. The jump-spark system of ignition is employed. The bearings are stated to be of ample dimensions, lined with a special bearing metal and reamed to size. Crank shafts are of forged steel and the connecting rods are made of bronze. All cap screws are held by lock washers or cotter pins where necessary to prevent loosening. The Lackawanna reversing device obviates, so the catalogue states, the necessity for reversible blade propellers or reversing gear.

L. S. STARRETT says:

If you find any tools better than Starrett Tools—buy them.



Send for Free Catalogue No. 17L of Starrett Tools, 176 pages.

The L. S. Starrett Co.

Athol, Mass., U. S. A.

A Business Proposition

FOR SALE AT A BARGAIN

A complete set of patterns of marine machinery of all sizes. For full particulars, address

MARINE MACHINERY

Care MARINE ENGINEERING

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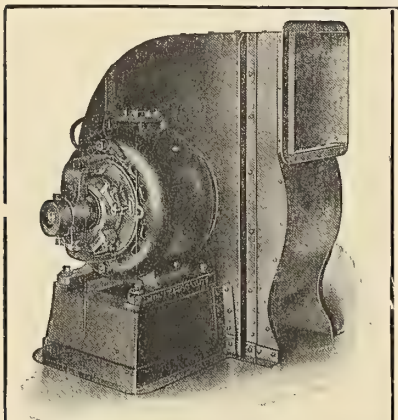


BLOWER OUTFITS FOR THE VENTILATION OF VESSELS

MOTORS FOR ALL PURPOSES ON SHIPBOARD, also ELECTRIC DECK WINCHES

INTERIOR TELEPHONE SYSTEMS, GONGS AND SIGNALS, ALSO ANNUNCIATORS FOR MARINE WORK, IGNITORS FOR MARINE GAS ENGINES.

THE HOLTZER-CABOT ELECTRIC CO.

BOSTON (BROOKLINE), MASS.

CHICAGO, 395-397 Dearborn Street, NEW YORK, 143 Liberty Street

DIXON'S
GRAPHITE
PIPE JOINT
COMPOUND

Very Useful on Shipboard

Not only upon piping of all sorts but upon bolts, nuts, caps, studs, etc. Threaded joints never rust or stick.

Write for new booklet 75-D, and free sample.

JOSEPH DIXON CRUCIBLE CO., JERSEY CITY, N.J.

Rules and measuring tapes are described in a folder issued by the Lufkin Rule Company, Saginaw, Mich.

An "Investigation of the Doble Needle Regulating Nozzle" is the title of a pamphlet issued by the Abner Doble Company, engineers, San Francisco, Cal.

"What! A Leather Belt Running in Water?" is the title of a folder issued by the Graton & Knight Manufacturing Company, Worcester, Mass. The company states that it has solved this problem, and that it is now making an absolutely water-proof leather belt. Catalogue and testimonials will be sent upon application.

Pressure and vacuum gauges, of the self-contained type, for every known purpose; marine clocks, engine registers, counters, speed indicators, steam engine indicators, gauge testing pumps, proving pumps, pop safety valves, water gauges, gauge cocks, air cocks, automatic air valves, oil and grease cups, thermometers, etc., are described in Catalogue No. 3, issued by the Standard Gauge Manufacturing Company, Syracuse, New York. This catalogue contains 106 pages and is profusely illustrated. The company calls attention to many new appliances illustrated which were not found in its last catalogue. As an illustration of the great variety of instruments the company manufactures, it states that it makes pressure gauges varying in weight from forty pounds to four ounces. Those interested should send for a free copy of this catalogue.

Variable speed motor drive for machine and machine tools is the subject of illustrated Bulletin No. 37, issued by the Northern Electrical Manufacturing Company, Madison, Wis. The bulletin states that machine shop operators have been hampered for years by reason of the fact that their machine work has cost too much. "Investigation of Northern variable speed motors will convince intending purchasers that our apparatus is economical in operation, efficient, compact, simple, and endowed with numerous exclusive features of merit which make it the only successful variable speed motor on the market. We solicit the inquiries of those interested in variable speed transmission."

Mullin's duplex-automatic regulator and mixer for fuel oil is described in a folder issued by the manufacturers, the Federal Valve Company, Seattle, Wash. The folder states: "On the steam pipe feeding the oil pump we install one of our patented stated pressure pump controllers, which regulates the pump action to deliver oil at any desired stated pressure regardless of steam fluctuations. The oil regulator and mixer, operated by a spring (which can be set to any desired pressure) on one side of a diaphragm and the initial steam pressure on the other, responds instantly to the slightest variations of steam pressure. When steam pressure falls below the desired point the spring exerts its excess pressure on the diaphragm, which is connected to and is a part of the valve rod, and opens the valves enough to admit the oil and steam for atomizing in its proper proportions to again restore the steam pressure. When this is accomplished and the steam pressure returns to the desired point, the valves automatically close, or nearly so, keeping just enough fire to maintain the pressure.

Pop safety valves, water relief valves, cylinder relief and snifting valves, boiler trimmings, globe, angle, straight-way and check valves for all pressures, are described in Catalogue No. 100, issued by the Crane Company, Chicago, Ill. This is a completely illustrated catalogue of 96 pages, giving price lists, tables of dimensions, and much detailed information. Regarding the company's safety valves, the catalogue states that their construction embodies a self-adjusting feature automatically regulating the pop of the valve, producing the least waste of steam between the opening and the closing of the valves. In order to allow the valve to close promptly and easily, a self-adjusting auxiliary valve and spring are attached, which are entirely independent of the main valve and spring. The steam in the pop chamber finds a passage through holes into an annular space provided in the auxiliary valve or disc, and by reason of the light auxiliary spring this pressure lifts the auxiliary valve and allows the steam in the pop chamber to escape gradually, thus permitting a great range in setting pressures with small waste of steam, and at the same time supplying a cushion, thereby preventing hammering and affording the easiest possible action in closing.

WATCH THIS SPACE FOR OUR NUMEROUS SPECIALTIES.

WALWORTH MFG. CO
TOOLS and SUPPLIES for STEAM WATER and GAS USERS
BOSTON MASS.

GOLD MEDAL—ST. LOUIS EXPOSITION
FOR
VALVES, BRASS and IRON GOODS, PIPE FITTINGS, ETC., ENGINEERS', GAS and STEAM FITTERS' TOOLS
AWARDED 1904, TO
WALWORTH MFG. CO., Boston, Mass., U. S. A.
Boston, 128-136 Federal Street New York Office, Park Row Building
Write for Pocket Catalogue.

JOBBERS SELL THEM—IF YOURS DON'T, WRITE.
New York, Park Row Building. WALWORTH MFG. CO., Boston, 128 Federal Street.
Write for our BLUE CATALOGUE "D." showing complete line of engineers' pipe fitting tools.

The Barr surface condenser with vacuum and circulating pump is illustrated and described in a mailing card sent out by the Barr Pump Company, Lehigh avenue and Eighteenth street, Philadelphia, Pa. The card says: "our condensers share with our pumps the Barr characteristics of extra strength and workmanship."

Hindley worm gears and spirals are the subject of a 92-page, illustrated catalogue issued by Morse, Williams & Co., Philadelphia, Pa. The catalogue states that the advantages of Hindley worm gears is that they have a greater number of teeth in contact, and for a given pitch have a greater depth of tooth and a wider face, and therefore a given load on the pitch diameter of the gears is distributed over a greater area, with less pressure per square inch of contact. The gears, so the catalogue states, are particularly adapted to the reduction of speed from motors.

An automatic steam flue cleaner.—The Globe Brass Works, Detroit, Mich., is mailing a folder describing its automatic steam flue cleaner. The folder states that the head is made to fit on the face of the flue, and when pressed against it the valve opens, permitting the steam to enter in a spiral shape, thereby removing all soot and other matter instantly. When released the steam is shut off by the pressure closing the valve, allowing cleaner to be passed to the next opening without disturbing the soot gathered in the fire box and blowing it all over the operator and boiler room. The head and couplings are made of heavy brass, and will stand high pressure.

The Chandler planer is illustrated and described in a catalogue issued by the Chandler Planer Company, Ayer, Mass. Among the good qualities the manufacturer claims are: Any cutting speed up to ninety feet per minute; if cutting speed does not exceed sixty-five feet per minute, a return speed of 200 feet per minute; if cutting speed exceeds 65 feet per minute, a return speed of 150 feet per minute; a variable speed device that increases the belt ratio in exact proportion to the reduction of the platen speed; two return speeds to every cutting speed. Case hardened shafts. A feed regulating device by which the feed may be instantly varied through its entire range, by moving a lever on a marked dial.

Taylor water tube marine boilers are illustrated and described in a 78-page catalogue, issued by the Taylor Water Tube Boiler Company, 322 Franklin street, Detroit, Mich. In designing these boilers it was the aim of the makers to produce a boiler that would be purely a water tube boiler without qualifications, with all the advantages inherent to that type, and yet one that would embody in its designs adherence to certain rules of steam generation derived by experience, the adherence to which is not peculiar to any one type of boiler, but which, the catalogue states, are frequently disregarded in the water tube type. In the catalogue the Taylor water tube boiler is described in its smallest detail, and how the well-known difficulties experienced in the use of water tube boilers, past and present, have been overcome.

"Western" marine gasoline engines are the subject of an illustrated folder issued by the Western Launch and Engine Works, Michigan City, Ind. The folder says: "While we have no apology to offer for our production of 1904, we are always alive to the benefits of maintaining the highest standard of excellence, and as improvements become apparent and desirable, they will be made. Our 1905 machine will be practically the same as our 1904 in design, but will contain several minor changes, principally with reference to increasing durability of wearing parts and in making the engine a little neater in appearance. Heretofore we have always given particular attention to the inside of the engine, possibly neglecting a trifle the general outward appearance. Our aim from now on will be to have the general appearance and finish of the engine in harmony with the quality of workmanship and materials used."

To Paint a Vessel White

with anything but **Oxide of Zinc** paint is to commit a wasteful act of folly. All ship painters know or ought to know that there is no marine white except

Zinc White

FREE: OUR PRACTICAL PAMPHLETS

"The Paint Question,"
"Paints in Architecture,"
"Specifications for Architects,"
"Paint: How, Why and When;"
"French Government Decrees."

THE NEW JERSEY ZINC CO.
71 BROADWAY
NEW YORK

We do not grind zinc in oil. List of manufacturers of zinc white paints will be furnished on request.

CONDENSER TUBES

last longest if made of

"BENEDICT-NICKEL"

ELECTROLYSIS is positively resisted because "Benedict-Nickel" is an alloy of nickel and copper.

CORROSION is impossible, as the tubing is so perfectly homogeneous.

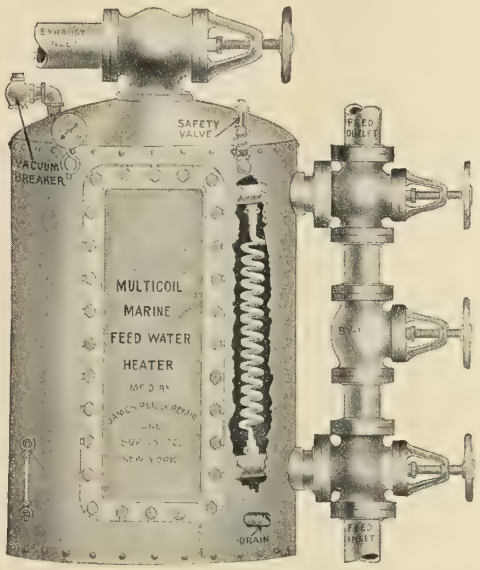
Our treatise on "Electrolysis of Condenser Tubes" is very valuable and costs you nothing. Send for it.

BENEDICT & BURNHAM MFG. CO.
WATERBURY, CONN.
New York, 253 Broadway Boston, 172 High St.

About Your Heaters

No crawling or leaky tubes—perfect elasticity—light weight—no air pocketing—entirely automatic—only one pump required.

In our heater, the water flows from a cooler to a warmer zone, and in this way one square foot of our coil heater does as



much work as two square feet of tubes. The efficiency of a heater depends not on the quantity of surface, but on the agitation of the liquid and its velocity of flow. Our coils are arranged to agitate and rotate the water during its passage.

With our heater, it is merely a matter of opening the side door and all the coils are accessible for removing the grease, which is impossible in a straight tube heater.

Will you read the

Tri-City Supply House's

"Feed-Water Sense" Booklet?

Mfrs.

THE JAMES REILLY REPAIR & SUPPLY CO.

Main Office, 229 West Street
NEW YORK CITY

AWARDS AT THE ST. LOUIS EXPOSITION.

THE BUFFALO GASOLINE MOTOR COMPANY, Buffalo, N. Y. Highest award for gasoline engines.

THE NORTON EMERY WHEEL COMPANY, Worcester, Mass. Two grand prizes and two gold medals.

THE SIROCCO ENGINEERING COMPANY, 22 Thames street, New York city. A grand prize for fans and blowers.

THE GOLDSCHMIDT THERMIT COMPANY, 43 Exchange place, New York city. A grand prize for the company's new welding process.

AUGUST MIETZ, 128 Mott street, New York city. A gold medal and special diploma for oil engines.

THE BOSTON & LOCKPORT BLOCK COMPANY, 160 Commercial street, Boston, Mass. A gold medal for improvements in tackle blocks.

THE WESTINGHOUSE COMPANIES, Pittsburg, Pa. Twelve gold medals, four silver medals, and one bronze medal for electrical machinery and appliances.

THE EUREKA FIRE HOSE COMPANY, 13 Barclay street, New York city. A gold medal for its "Eureka," "Paragon," and "Red Cross" brands of seamless rubber lined fire hose.

THE C. W. HUNT COMPANY, West New Brighton, N. Y. A gold medal for its narrow-gauge industrial railway, and a silver medal for its electric storage battery locomotive.

THE WALWORTH MANUFACTURING COMPANY, 128 Federal street, Boston, Mass.—A gold medal for valves, brass and iron goods, pipe fittings, engineers', gas and steam fitters' tools, etc.

THE KEUFFEL & ESSER COMPANY, 127 Fulton street, New York city. The grand prize for instruments of precision, philosophical apparatus, etc. A gold medal for instruments and equipment for underground surveying.

BUSINESS NOTES.

THE STEAMSHIP, railway, and mill supply business carried on for twenty-five years by the late H. A. Rogers, at 19 John street, New York city, will be continued at the same location by the H. A. Rogers Company.

A SCRAPING TOOL FREE.—The Mound Tool and Scraper Company, 712 Howard street, St. Louis, Mo., will send a free souvenir scraping tool with every order for Mound packing tools from those who mention MARINE ENGINEERING.

THE STAR CONDENSER PACKING TOOL has revolutionized the packing of tube ends of surface condensers, according to the claim of its makers, Matteson & Drake, The Bourse, Philadelphia, Pa. Those interested should send for a catalogue.

AN IMPROVED DROP HAMMER.—The Billings & Spencer Company, Hartford, Conn., says: "When you buy a Billings & Spencer patent, improved drop hammer, you get a machine exactly like those used in our own plant in producing our enormous output of drop forgings of every description. Catalogue D for the asking."

"THIS IS THE DAY OF THE MOTOR DRIVE," says the Stow Flexible Shaft Company, Philadelphia, Pa. So the company has fitted its shaft to the General Electric Company's motor, and the result, it is claimed, "beats any arrangement ever invented for drilling, tapping, reaming or grinding." Free catalogue upon request.

GALVANIZED BAR IRON, SPIKES, NAILS, CHAIN, ETC., in stock for immediate shipment, are advertised by the United Galvanizing Company, Inc., 525 North Front street, Philadelphia, Pa. This company claims to have the largest galvanizing plant in the country, and states that it makes a specialty of large orders.

Moncrieff Scotch gauge glasses are advertised by H. A. Rogers Company, manufacturers of engineers' supplies, 19 John street, New York city.

All types of working and pleasure craft, up to 150 feet in length, are made by the Standard Boat Company, Long Island City, N. Y. This company is building a high-speed steam launch for use in Mexico.

Ball bearing, vertical letter filing cabinets, with drawers which run on ball bearing attachments, eliminating all friction, are manufactured by the Wagemaker Furniture Company, Ltd., Grand Rapids, Mich. These cabinets are in great demand in drafting rooms and offices of all kinds. Catalogue L will be sent upon application.

Will enlarge factory.—The Delaware Marine Supply Manufacturing Company, Wilmington, Del., is building a 100 by 40 foot, two-story factory building which will contain a large polishing room, plating, lacquering, cleaning, and store rooms. The increase in the company's business has made this addition to its factory necessary.

A new marine gasoline engine.—Frank I. Hitchcock, Bridgeport, Conn., has built a factory, dock, and office at 130 Seaview avenue, and is taking orders for gasoline engines up to 100 horse power. Mr. Hitchcock states that these engines are constructed by gasoline engine builders of long experience and that only the best materials and workmanship enter into their construction.

A satisfactory dry dock.—The railway dock recently built by the H. I. Crandall & Son Company, East Boston, Mass., for the Portland Shipbuilding Company, Portland, Me., has been successfully tested. The H. I. Crandall & Son Company has received a contract to build a 1000-ton railway dry dock for Wm. Kehoe & Sons, Savannah, Ga. The company has also nearly completed a dock at Clayton, N. Y.

Northern electrical motors.—The Northern Electrical Manufacturing Company, Madison, Wis., has received from the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., the contract to supply the electrical equipment for its works. This contract was received after the subject of electrical machinery had been carefully investigated for the Cutler-Hammer Company by Sargent & Lundy, consulting engineers, Chicago, Ill.

A fast motor boat.—The motor boat *Ontario*, built by the Electric Launch Company, Bayonne, N. J., for Commodore H. B. Moore, of the Atlantic Yacht club, during her trial trip on the Hudson river, November 6, made a mile at the rate of 24.66 knots an hour, according to the official figures. Mr. H. R. Sutphen, general manager of the Electric Launch Company, states that on her trip up the river the boat made twenty-five miles in forty-two minutes, and that she is capable of maintaining this speed for a distance of 150 miles.

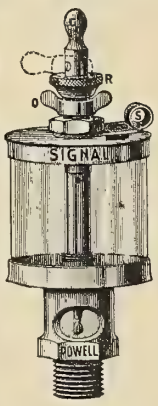
POWELL PATENT "SIGNAL" OILER

AS RECONSTRUCTED

FOR HIGH-GRADE, HIGH-CLASS ENGINES

Signal Lever Up—Oil Dropping

Signal Lever Down—Dropping Stopped



Convenient to fill. Easy to regulate. When once the required rate of feed is obtained it need never be disturbed. If desired to stop the flow of oil, simply drop the lever, as shown by the dotted lines; to again start the flow, raise lever to an upright position. A first-class, reliable Oiler in every sense of the word.

THE WM. POWELL CO.

Manufacturers of Everything in the Steam Line for the Boiler and Engine Room.

Send for Complete Illustrated Catalogue.

CINCINNATI, O., U. S. A.

New York Depot, H. H. BEALS, 51 Cliff St.

Philadelphia Depot, C. J. RAINEAR & CO., 518 Arch St.

A Chance Courtship

is a story of an unconventional love match, well told and beautifully illustrated. As a bit of readable fiction the story is well worth writing for. It is contained in a handsomely bound book of 128 pages, a portion of which is devoted to the attractive mountain and lake resorts along the Lackawanna Railroad. It is a book you will like to see. It may be had by sending 10 cents in postage stamps to T. W. Lee, General Passenger Agent, Lackawanna Railroad, New York.

UNITED STATES METALLIC PACKINGS

FOR PISTON RODS AND VALVE STEMS OF MAIN AND AUXILIARY ENGINES

RELIABLE—SATISFACTORY—EFFICIENT

The United States Metallic Packing Co.

427 North Thirteenth St., PHILADELPHIA. CHICAGO, 509 Great Northern Bldg.

MOTOR BOAT AND SPORTSMAN'S SHOW

MADISON SQUARE GARDEN, NEW YORK CITY

FEBRUARY 21 TO MARCH 9, 1905

Address, J. A. H. DRESSEL, General Manager, 1135 Broadway, N. Y.

AN EFFICIENT OIL PURIFIER.—Patterson, Gottfried & Hunter, manufacturers of engineers' supplies, 146 Centre street, New York city, say: "Do you understand the difference between filtering oil and purifying it? Filtering thins the oil and wastes it, but the McClelland oil purifier will save 50 per cent. of your oil bills. An illustrated booklet tells why. Shall we send it?"

MILLIVOLTMETERS, VOLTAMMETERS, MILAMMETERS, ohmmeters, portable galvanometers, ground detectors and circuit testers are made by the Weston Electrical Instrument Company, Waverly Park, Newark, N. J. The company states that its portable instruments are recognized as the standard the world over.

A NEW STEEL-CASTING PLANT.—The Standard Roller Bearing Company, 48th street and Girard avenue, Philadelphia, Pa., has bought a large tract of land near its factory, and will build a steel-casting plant and a large addition to its foundry. The company's business has greatly increased under the management of Mr. S. S. Eveland.

SPECIALTIES IN BRONZE, SOLID PROPELLERS of any size or pitch, adjustable propellers, reversible and self-clearing propellers, castings for hydraulic purposes, gasoline and kerosene engine fittings of all kinds, steering wheels, brackets, chocks, cleats, deck plates, and other marine hardware are manufactured by the Norwalk Brass Company, Norwalk, Conn.

A RELIABLE CIRCULATING PUMP is one of the essential features of all water jacketed gas or gasoline engines, and the more simple, compact, and durable it is, the less liability there is of its getting out of order and impairing the efficiency of the engine. To meet the demand a bronze pump especially designed for such use has been placed on the market by the Brown & Sharpe Manufacturing Company, Providence, R. I.

TWO-CYCLE MARINE GASOLINE ENGINES, ranging in size from two to eight horse power, are built by the Toquet Motor Company, Saugatuck, Conn. The company states that all double cylinders are cast in one piece, and both controlled by the same mechanism; that all parts are interchangable; that the igniter is simple, positive and durable, and that the bearings are of sufficient size to insure cool running.

NEW LAUNCH AND ENGINE WORKS.—The Western Launch and Gas Engine Works, Mishawaka, Ind., which manufactures "Recreation" launches and "Western" gas engines, will remove its office and works to Michigan City, Ind., where it has secured an excellent location on the harbor front, on which it will erect a two-story factory containing a complete equipment of modern machinery. The company has been reorganized under the name of the Western Launch and Engine Works, Inc. Dr. F. R. Warren is president, Robert Zorn vice-president, Emil Klopsch secretary and treasurer, and James A. Reeves is manager. The company will build boats of all kinds, from a small row boat to a 75-foot cabin yacht.

BLOCKS FOR SHIPS, YACHTS, and marine work of all kinds are advertised by Merriman Bros., 162 Commercial street, Boston, Mass. This company designs and makes special blocks for special purposes. Catalogue sent upon request.

MARINE SUCTION GAS PLANTS.—Mr. C. W. Whiting, 812 Exchange building, Boston, Mass., who has had many years' experience as a gas engine expert, is prepared to install suction gas plants in yachts and other boats where efficient and economical power is desired. Additional information regarding the system may be had upon application.

SHEET PACKINGS, GASKETS, FLANGE RINGS, piston rod packings, valve stem and cylinder packings, for ordinary or superheated steam, air, acid, and oil, are manufactured by the H. W. Johns-Manville Company, 100 William street, New York city. The company makes a specialty of its "Kearsarge" packing, for which great superiority is claimed in point of efficiency, durability, and economy.

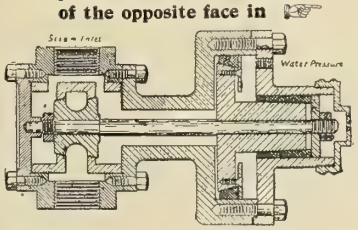
FALLS HOLLOW STAYBOLTS IN JAPAN.—The Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, has received an order from the Kiushiu Railway Company, of Japan, for 47,200 pounds of Falls Hollow round staybolt bars. The Kiushiu Railway Company has made severe tests of these staybolts, which have resulted most satisfactorily. Other Japanese railways and the Norwegian State railways are also using the Falls Hollow staybolts.

THE KEASBEY & MATTESON COMPANY, Ambler, Pa., is having a large demand for a new specialty, which is a sort of fireproof board designed especially for bulkhead and partition work on board vessels and yachts of all kinds. It is composed of magnesia and other fireproof materials, is strong, and can be painted and given the attractive appearance that wood can. Samples of this material can be had upon application to the company.

A SATISFACTORY STEAM TRAP.—E. F. Houghton & Company, 3d and Somerset streets, Philadelphia, Pa., has received the following report from Otto Fries, chief gunner in charge of the United States naval magazine, Iona island, N. Y.: "Regarding the Marck steam trap, from E. F. Houghton & Co., Philadelphia, Pa.: This steam trap has been in constant use since it was received at this station, April 20, 1904, and has given excellent results."

A WELL-KNOWN SUBMARINE COMPOUND.—Samuel J. Williams & Co., 70 Broad street, New York city, report that they have been making anti-corrosive and anti-fouling compounds for iron and steel vessels for sixty-one years. The Williams compound is recognized as being of especial value in tropical waters. It is used by the United States navy and revenue cutter service, by the Old Dominion line, the Red D line, by the Pacific Mail Steamship Company, and by many other lines. The manufacturers have numerous agents and can give estimates on docking and painting at almost any dock in the world.

BY putting the Steam Pressure on one face, and the water pressure on the reduced area of the opposite face in



MULLINS AUTOMATIC
CONTROLLER FOR FEED PUMPS,

a water pressure in excess of the steam pressure is maintained absolutely without regard to the fluctuations of the steam.

The large piston area renders it extremely sensitive to the slightest varation in water pressure, maintaining a high degree of uniformity in both water level and steam pressure, saving fuel and protecting both boiler and engine.

A booklet, now in preparation, will tell you all about the Mullins Automatic Controller. We want you to have a copy of that book.

FEDERAL VALVE CO., 2534 Western Avenue, SEATTLE, Wash.

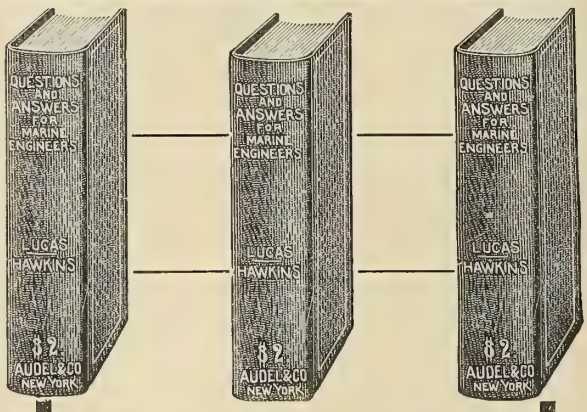
CHAIN PIPE WRENCHES.—J. H. Williams & Company, manufacturers of drop forgings, Brooklyn, N. Y., state that they have two kinds of chain to sell with the "Vulcan" chain pipe wrench, but that one of them is superior to the other. The company's flat link chains are from 25% to 50% stronger than its cable chains, which the United States and the British governments have pronounced "unsurpassed."

MR. CHARLES LANG, formerly with the Wheeler Condenser and Engineering Company, 120 Liberty street, New York City, has joined the sales department of the A. D. Granger Company, at the New York City office, 95 Liberty street. Mr. Lang will make a specialty of pumps and condensers, the Granger Company having acquired the agency for the Bar Pump Company, of Philadelphia.

NICHOLSON SHIP LOGS.—The Nicholson Ship Log Company, 204 Superior street, Cleveland, Ohio, in advertising its ship log, states: "You do not have to guess at the speed of your vessel if equipped with the Nicholson log. The exact speed of the moment is constantly before you on a dial and is recorded on a paper chart. The distance traveled is correctly shown on a counter. Guaranteed to register within two per cent. No expense to operate if not abused. Wind the clock once a day and it will do its work automatically."

AN EXCELLENT ANTI-FOULING PAINT.—The Hertzog Paint and Varnish Company, 627 Cherry street, Philadelphia, has received the following letter from Mr. George Lewis, master of the steam yacht *Ituna*, New London, Conn: "When the *Ituna* was hauled out, on September 29, after being in the water since June 21, her bottom was in remarkably good condition. Except for a little grass for about two feet down from the water line, there was only a slight scum on the surface. When this was removed the paint was found to be almost as good as when it was applied. It had not cracked, or flaked off anywhere. Above the water it looked as clean and bright as when it was put on. The paint has given the best satisfaction of any we have ever used."

MECHANICAL DRAFT APPARATUS.—The American Blower Company, Detroit, Mich., states that the application of fans to induced draft work has made many changes from the established standards of fan builders in order to avoid difficulties never met with in other lines of fan work. Many of the fans on the market are built with two or three spiders, except in the very small sizes. A fan of the standard type usually has a bearing on each side, making the distance between bearings comparatively short. With this arrangement there is no deflection to the shaft, and the fan wheel runs smoothly. But when these fans have to be adapted to the handling of hot gases it is necessary to keep the bearings removed from the path in which the gases travel as the bearing would become overheated. This necessitates either having an overhung wheel or placing one bearing outside of the inlet chamber built onto the side of the fan. Unless the bearings are placed very close to the center of the fan the overhang will cause deflection which will work the keys loose and perhaps cause the fan wheel to strike the housing. The same is in a large measure true of the two bearings far apart. Increasing the diameter of the shaft is not a relief, as by its own weight it will deflect. Then, again, the intense heat within the housing causes it to expand, and as the steel frame work of the housing is outside and at a much lower temperature than the shell, the natural curvature, if any, is inward. Just how much this expansion will amount to can never be predetermined, hence the greatest of care in setting up will often prove of no value when the fan is put into operation, causing the wheel to strike on one or the other of the sides or at certain points. These are points for serious consideration with any one who has had experience with this line of work. The American Blower Company has devoted a great deal of time to the improvement of these details, and will be glad to send the results of its experiments describing the improvements it has made to all who are interested.



THIS work is a most complete treatise, covering a course in mathematics, the management of marine engines, boilers, pumps, and auxiliary apparatus, the accepted rules for figuring the safety-valve, etc.

The book is divided into two parts: Part I, Construction; Part II, Operation; it contains 700 pages; 807 questions with carefully prepared answers, with nearly 300 explanatory foot-notes; it is illustrated with plate drawings, diagrams and cuts, and an index with more than 1,000 ready references; the volume is 5¼ x 8½ inches, 1½ inches thick, and weighs nearly three pounds; it is strongly and durably bound in rich green cloth, with full gilt edges.

Price, $2, postpaid to any address

FIFTEEN DAYS' EXAMINATION

To all readers of Marine Engineering and friends we will send without any expense, subject to fifteen days' inspection, a copy of this work.

We make this offer to get the volume more widely known among the members of M. E. B. A. The book is approved by the authorities and endorsed by the leading men in the profession.

If after the book is received it is not found satisfactory, it can be mailed back to the publishers. It is shipped in a patent wrapper so it can be reforwarded with very little trouble if not purchased. But to see this treatise is to want it.

INSPECTION BLANK

Date.....

To **THEO. AUDEL & CO.**
63 Fifth Avenue, New York City

Accepting your offer to allow me to examine a copy of "Questions and Answers for Marine Engineers," I ask you to mail a copy, postpaid, subject to fifteen days' examination, and if I find same satisfactory I agree to send you $2.00 in payment or return you the book after of fifteen days.

Name.....

Address.....

Occupation.....

.....

.....

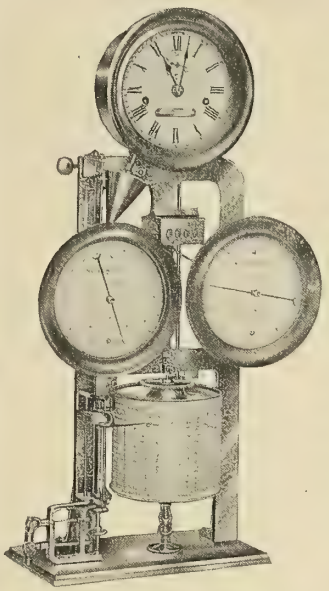
Money Refunded if Not Entirely Satisfactory

SEND FOR MARINE CATALOG

THEO. AUDEL & COMPANY
PUBLISHERS
63 FIFTH AVENUE, NEW YORK

YOU do not have to guess at the speed of your vessel if equipped with the

Nicholson Log



The exact speed of the moment is constantly before you on a dial and is recorded on a paper chart. The distance travelled is correctly shown on a counter. Guaranteed to register within 2%. No expense to operate if not abused. Wind the clock once a day and it will do its work automatically.

Catalogues and Full Information on Request.

Nicholson Ship Log Co.
204 SUPERIOR STREET, CLEVELAND, O.

Wagemaker Ball-Bearing Vertical Letter Filing Cabinets

with drawers which **run** on **ball-bearing** attachments **entirely** overcome **all** friction or binding. **Each** drawer will accomodate **5,000 papers.**

January First you will transfer your **Old Year's** papers and get systems started for the **New Year's** business.

Order one of our systems and cabinets, with the **Ball-Bearing** Vertical Filing drawers in, and have the **best** obtainable. **No other line has this feature.**

Our systems and filing devices are the **most modern** in use **anywhere** and are **easily** adapted to **every** department in **any** business.

We manufacture a **complete** line of **solid** and **sectional** cabinets, card index systems, etc. An exhibit of our goods and systems will be made in **Booth No. 95** during the **Office Appliance** and **Business System Exhibition** at **Madison Square Garden, New York City, December 12, 13 and 14.**

Write on business stationery for our new ***Catalogue L.*** *Address*

WAGEMAKER FURNITURE CO., LTD.
EXCLUSIVE MANUFACTURERS OF BUSINESS OFFICE SYSTEMS
450 So. Market St., GRAND RAPIDS, MICH., U. S. A.

THOSE REQUIRING MARINE MACHINERY for stern or side wheelers, or propeller-driven boats, marine boilers, propeller wheels, steam launches, tug boats, shallow draft boats and machinery, should write to the Marine Iron Works, Station A., Chicago, Ill., for trade literature.

SPACE AT THE MOTOR BOAT EXHIBITION.—Following the allotment to members of the National Association of Motor Boat Manufacturers, there still remains some space at the motor boat exhibition, to be held in conjunction with the Sportsmen's Show, at Madison Square Garden, New York city, in February. This space will be given to those making first application, and after it is gone there will be no more room for motor boats during the two weeks' exhibition.

THE PARSONS MARINE STEAM TURBINE COMPANY, LTD., 97 Cedar street, New York City, is prepared to grant licenses in the United States for the building of Parsons turbines for the purpose of marine propulsion. The advantages of the turbine system the company states to be absence of vibration, increased economy in coal consumption, reduced cost of attendance on machinery, reduced consumption of oil and stores, reduced diameter of propeller, giving increased facilities for navigating in shallow waters, and reduction in racing of propellers.

YACHT SAIL MAKERS.—Wilson & Silsby, Rowe's Wharf, Boston, Mass., call attention to the fact that they make a specialty of sails for racing yachts. They have furnished sails for the following well-known yachts: *Constitution, Defender, Volunteer, Jubilee, Colonia, Independence, Ailsa, Navahoe, Weetamoe, Uncle Sam, Effort, Calypso, Flirt, Ariadne, Quissetta, Constance, Intrepid, Vergemere, Resolute, Chanticleer, Senta, Snapper, Raider, Little Haste, Sally VII, Chloris,* and many others. They have on hand constantly high-grade sail cloth, manufactured especially for them.

ASSISTANT CYLINDERS FOR VALVE GEARS.—Mr. Luther D. Lovekin, 6320 Drexel Road, Overbrook, Philadelphia, Pa., has placed on the market an assistant cylinder for valve gears, which he states is a money saver for the steamship owner, a labor saver for the engine-room force, and a guarantee that the valve gear will work perfectly. Mr. Lovekin states this his invention may be applied to any engine, old or new, without difficulty, and that it is now in use on engines aggregating more than 130,000 horse-power, among which are the *Texan,* of the American-Hawaiian Steamship Company; the *Massachusetts,* and the *Mississippi,* of the Atlantic Transport Steamship Company; the *Manchuria* and *Mongolia,* of the Pacific Mail Steamship Company, and the *Ontario,* of the Merchants' and Miners' Transportation Company, It has also been ordered fitted to the U. S. Cruiser *Washington* and the U. S. battleship *Kansas.*

A CYCLOPEDIA OF APPLIED ELECTRICITY.—The American School of Correspondence, at Armour Institute of Technology, Chicago, Ill., is publishing a cyclopedia of applied electricity in five volumes, which is intended to be a practical guide for marine engineers, stationery engineers, electricians, engineering students and all persons interested in electricity. There are five hundred pages in all, fully indexed. Every section is said to be written by an acknowledged authority. A limited number of introductory sets will be sent free for examination as soon as received from the press. The regular price of the set is $30, and the American School of Correspondence states that it will accept reservation orders until the books go to press for $12.50. Those desiring to have a set reserved at the reduced price must send $2.50 with the application, as an evidence of good faith. The books will be sent prepaid on approval, and may be returned at the school's expense if not satisfactory. Those writing to the American School of Correspondence and mentioning MARINE ENGINEERING, will receive full particulars and a partial table of contents.

THE WEBSTER SYYTEM OF STEAM CIRCULATION, made by the Warren Webster Company, Camden, N. J., is being installed in the new Wanamaker stores in New York and Philadelphia.

REAR ADMIRAL GEORGE W. MELVILLE, Ex-Engineer-in-Chief of the United States Navy, has formed a partnership with Mr. John H. Macalpine, M. I. N. A., under the name of Melville & Macalpine. The new firm will conduct business at 615 Walnut street, Philadelphia, Pa., as consulting engineers and naval architects.

A NEW MARINE SUPPLY COMPANY.—Captain H. J. Howes, James Otis Porter and Hollis Burgess, have entered into the marine supply business under the name of the Maritime Stores Company, with stores and office at Lewis' Wharf, 38 Atlantic avenue, Boston, Mass. The new company has a private landing and has launches running about the bay to deliver goods. The company is prepared to furnish a large variety of maritime supplies, fruit, meats, canned goods and provisions of all kinds, rope, blocks, chandlery, paints, oils, varnish, etc. The store will be kept open all night.

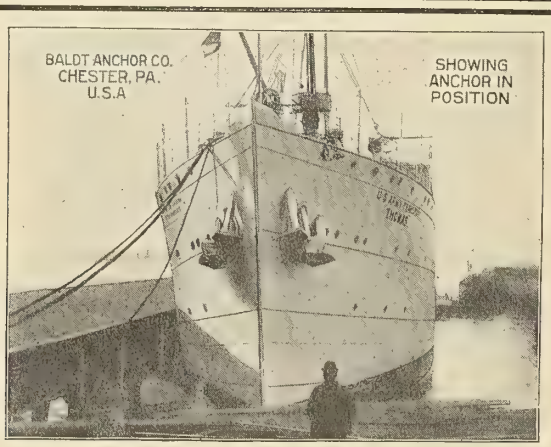
CONTRACT FOR COAL-HANDLING MACHINERY.—The Wellman-Seaver-Morgan Company, Cleveland, Ohio, has received a contract to construct two large coal-handling machines for the Boston Coal Dock and Wharf Co., Duluth, Minn. This is one of the docks under the management of the St. Paul & Western Coal Co. The machines will consist of two conveyor bridges, each about 350 feet long, including front and rear cantilevers. They will be designed so that coal may be screened and loaded into box cars as well as unloaded from vessels, and will be built to be operated by steam. They will be equipped with 2-ton Hulett patent excavating buckets, and machinery designed to give maximum speeds of operation. The structural work will be of steel throughout, and the machines will be self propelling along the dock.

Gas Engine Business
FOR SALE

Including Complete Set of Patterns for all Sizes

The engine has been on the market several years and has made an excellent reputation. For full information, address

GAS ENGINE, care Marine Engineering
17 Battery Place, New York



MARINE ENGINEERING
EMPLOYMENT BUREAU.

Full information regarding the purposes of this bureau, together with instructions regarding registration, etc., furnished upon application to MARINE ENGINEERING Employment Bureau, 17 Battery Place, New York City.

All correspondence, concerning either vacancies or situations wanted, is strictly confidential.

POSITIONS SEEKING MEN.

BOILER-SHOP FOREMAN. Must be familiar with various types of marine boilers and capable of handling repair work. Knowledge of shipbuilding and repairs will be of great advantage. File 10.

FOREMAN FOR BOAT BUILDING SHOP who has had experience in constructing new hulls, who can attend to repair work and is familiar with gas engines. File 15.

GAS ENGINE BUILDER wanted to combine his business with a boat building and repairing shop which has marine railways and an established business. File 40.

SHEET IRON WORKERS, erecting machinists, and steam fitters wanted who have had experience in marine work. File No. 42.

SKILLED BOAT BUILDER who has had experience in handling men, and who can attend to the hull work in large launch works. File 14.

STEAMFITTER AND COPPERSMITH acquainted with plumbing, and able to make estimates; also to take charge in a general way of plumbers, coppersmiths and steamfitters. File No. 36.

YACHT AND BOAT BUILDER wanted who understands inside joiner work and who is able to superintend the building of launches and yachts under all the branches. File No. 39.

MEN SEEKING POSITIONS.

We have applications registered for positions as follows, and the references of each applicant have been carefully investigated:

ASSISTANT SUPERINTENDENT, ENGINEER OR ASSISTANT ENGINEER IN ENGINEERING WORKS. Age 28; single; of English birth; has British and American licenses and has had several years' sea experience. Application No. 23.

BOILER-SHOP FOREMAN. Age 35; single; many years' experience in Navy Yard and leading shipyards. Application No. 59.

CHIEF OR ASSISTANT CHIEF DRAFTSMAN—ENGINE. Age 33; married; has had sea experience and thirteen years as leading and chief draftsman of private and government shipyards. Application No 25.

CONSULTING ENGINEER AND NAVAL ARCHITECT. Married; born in Germany; had many years' experience in designing, drafting and surveying. Application No. 33.

DESIGNER AND DRAFTSMAN. Has had many years' experience in launch and river boat work. Designed some of the fastest river boats in the country. Application No. 61.

DRAFTSMAN, ENGINE AND BOILER. Age 30; unmarried; has Danish marine license; technical school graduate. Application No. 57.

DRAFTSMAN—HULL. Age 20; single; experienced in architectural work, but prefers marine drafting. Application No. 51.

DRAFTSMAN—HULL. Age 25; married; 9 years' experience in leading yards in drafting, testing materials, surveying, etc. Application No. 54.

DRAFTSMAN—HULL, OR INSPECTOR. Age 37; married; had experience both in government yards and private yards. Application No. 30.

DRAFTSMAN—HULL. Age 22; single; born in Norway; studied Technical schools in Norway and Germany; experience as draftsman, also as shipfitter. Application No. 31.

DRAFTSMAN—HULL. Age 27; single; has had six years' experience on government work and in private yards; graduate of Webb's Academy. Application No. 65.

DRAFTSMAN—HULL AND ENGINE. Age 26; single; graduated Webb Academy; has had four years' experience in navy yard work; desires connection with private shipyard. Application No. 41.

DRAFTSMAN—ENGINE. Age 26; single; 12 years' experience in drafting; excellent penman. Application No. 18.

DRAFTSMAN—ENGINE, STEAM OR GAS. Forty-three years old; single; born in Germany; has had extensive experience in designing and drafting; has had sea experience. Application No. 32.

DRAFTSMAN—MARINE. Age 34; married; accustomed to intricate drafting work. Application No. 50.

DRAFTSMAN—YACHT. Age 26; single; studied Worcester and Massachusetts Technical Schools; had experience in buying and superintending construction work. Application No. 28.

ENGINE SUPERINTENDENT OR DESIGNER. Age 45; married; many years' practical experience in well-known shipyards with engines, auxiliaries, etc. Application No. 56.

ENGINEER OR ENGINE SHOP WORK. Age 29; single; English parentage; has British Board of Trade second-class license; many years' experience at sea and in setting up and caring for marine machinery. Application 58.

FOREMAN MACHINIST OR CHIEF ENGINEER. 31 years old; married; British and American licenses; born and learned trade in Scotland; experienced in estimating on repair work. Application No. 17.

FOREMAN—BOILER SHOP. Age 37; single; 16 years' experience in boiler shop work. Application No. 47.

GANG FOREMAN IN ERECTING SHOP OR FITTING UP ENGINES IN SHIPS. Age 37; married; has been with present employers 15 years. Application No. 26.

GAS ENGINE OPERATOR. Age 22; single; has had several years experience in caring for, and repairing of, gas engines. Will go to Florida for the season. Application No. 67.

GAS ENGINE OPERATOR. Age 28; single; born in Germany; 7 years' experience; understands gas engines thoroughly. Application No. 48.

HULL SUPERINTENDENT. Age 42; married; born and learned trade in Scotland; studied at Glasgow School of Naval Architecture; experienced as foreman; surveyor and hull superintendent. Application No. 27.

LAUNCH AND YACHT DESIGNER. Age 29; married; educated Massachusetts Institute of Technology; several years' experience in designing and construction work and gas engine building. Application 63.

LAUNCH AND YACHT SUPERINTENDENT AND DESIGNER Age 34; married; has had about fifteen years' experience in some of the best known launch and yacht building establishments in the country. Application No. 62.

LEADING DRAFTSMAN OR SUPERINTENDING ENGINEERING FOR STEAMSHIP LINE. Age 34; married; studied Massachusetts Institute of Technology; 11 years' experience in drafting and other marine work. Application No. 53.

LOFTSMAN. Age 33; single; has had eight years' experience as loftsman, foreman, and draftsman. Application No. 44.

MASTER OF STEAM YACHT. Age 37; married; born in Norway; has license as master and pilot on ocean steamer; has commanded several well-known yachts. Application No. 40.

MASTER OF SHIP OR YACHT. Age 40; 7 years' experience; has first class master's license for all ocean and coastwise steamers and pilot for most harbors on the coast. Application No. 39.

MASTER OR PIER SUPERINTENDENT. Age 38; has spent whole life at sea and has British Extra and American master's certificate; pilot New York and San Francisco; experience in handling men and cargoes. Application No. 35.

MASTER AND PILOT. Age 44; single; 11 years' experience; has license for 500 tons as master and pilot ocean and inland for New York, New Haven, and New London districts. Application No. 20.

OILER. Who has had experience on one of the well-known coastwise lines seeks position. Application No. 64.

OILER OR SHOP HAND. Age 21; single; born in Belgium; had considerable shop experience. Application No. 22.

SPECIAL NOTICES.

Announcements under this heading will be inserted at the uniform rate of thirty-three-and-a-third cents a line or fraction thereof, for the first insertion, and twenty-five cents per line for each subsequent insertion. Lines average ten words each. The heading counts as a line, as does also the address.

REPRESENTATIVE WANTED.

An experienced representative is wanted to handle patented steam specialties. Retired engineer preferred. See advertisement of Power Specialty Company.

TWO CYCLE GAS ENGINES, 3½ to 24 H. P., weighing from 120 lbs. to 600 lbs., are advertised by the Rochester Gas Engine Company, 700 Driving Park avenue, Rochester, N. Y.

A HIGH PRESSURE PACKING.—The Bostosking Packing and Supply Company, 170 Sumner street, Boston, Mass., is advertising a high pressure packing which it states is the "king of high pressure packing."

A NEW REVERSIBLE PROPELLER.—Those interested in reversible propellers should write to William E. Geyer, Cambridge, Mass., for literature on the subject of his new reversible propeller and general propeller designing.

THE CASE ENGINE for marine lighting, pumping or refrigerating plants, is said by its makers, the New Britain Machine Company, New Britain, Conn., to combine all the features which the latest practice requires in engines for direct connected purposes.

MARINE BOILERS, INTERNALLY FIRED TYPES, and centrifugal pumping machinery are manufactured by the Kingsford Foundry and Machine Company, Oswego, N. Y. The company will be pleased to send its trade literature to those interested.

HAS OPENED A NEW YORK OFFICE.—Mr. John Haug, 536 Bourse building, Philadelphia, Pa., consulting engineer and naval architect, surveyor to the British corporation, has opened an office in New York city. His address is care of Mather & Company, 51 Wall street.

PNEUMATIC TOOLS FOR SHIP YARDS—The Rand Drill Company, 128 Broadway, New York city, is calling attention to its products, stating that "shipyards, to be well equipped, should be fitted with our Imperial pneumatic piston drills, chippers and riveters."

MARINE GASOLINE ENGINES of the two and four cycle types, from 1½ to 25 horse power, built with reversible propeller or inboard reverse gear, as desired, are advertised by the Frank M. Watkins Manufacturing Company, 547 Baymiller street, Cincinnati, Ohio.

DREDGING AND DREDGING MACHINES.—The Atlantic, Gulf and Pacific Company, Park Row Building, New York City, is calling attention to its superior facilities for carrying on dredging operations upon a large scale. This company makes a specialty of land reclamation, and builds docks, piers, foundations and bridges.

SHIP RIGGER who has had many years' experience in ship work both on board ship and in shipyards. Application No. 41.

SUPERINTENDENT FOR STEAMSHIP COMPANY. Age 29; married; experienced in hull and engine drafting. Application No. 37.

SUPERINTENDENT. Many years' experience in managing a well-known shipyard, both in the securing of orders and executing them; has wide acquaintance. Application No. 19.

SUPERINTENDENT OF LAUNCH WORKS. Age 24; single; four years' experience, including boiler designing and hull drafting; educated Brooklyn Polytechnic School and Cornell University. Application No. 15.

SUPERINTENDING ENGINEER, CHIEF DRAFTSMAN, ESTIMATOR OR SURVEYOR. Age 34; married; born and educated in Scotland; 15 years' experience in Scotland, Ireland, and this country. Application No. 46.

The Peerless Spiral Piston and Valve Rod Packing

It will hold 400 lbs. of steam

Once tried always used

Will run twelve months in high speed engines

Arctic Packing

To be used exclusively for packing Ammonia Pumps

This packing is made in several hundred sizes

This packing is specially constructed for ice machine service, of layers of rubber and plies of duck which are so arranged and laid as to best resist the actions of ammonia, cold and heat.

The duck is a specially made duck, frictioned with an entirely new compound heretofore unknown to the rubber trade, and the core and back is of the celebrated **Rainbow Packing** compound, which is specially adapted to resist ammonia, cold and heat.

This packing is constructed on a strictly scientific basis, and the results obtained thus far have demonstrated fully its value for ammonia packing.

This packing is made in several hundred sizes. The rings may be slipped onto the rod very readily.

The usual rule is to be observed in giving measurements, the depth and width of stuffing box and size of piston rod, in order to get the size desired.

Sole Manufacturers of the

Celebrated Rainbow, Eclipse Sectional Rainbow Gasket, Hercules Combination and Honest John Packings.

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